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U.S. INDUSTRIAL MOBILIZATION 1918-1988

AN HISTORICAL ANALYSIS

THESIS

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U.S. INDUSTRIAL MOBILIZATION 1918-1988
AN HISTORICAL ANALYSIS

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirement for the Degree of
Masters of Science in Logistics Management

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September 1989

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Abstract

The capability of the U.S. industrial base to mobilize could mean the difference between victory and defeat in any future conflict in which the U.S. might find itself. Since World War I and the introduction of mechanization into combat the industrial base has played a major role in modern warfare. The industrial might of the U.S. grew to the point that it became known as the "Arsenal of Democracy" in World War II. There is evidence which suggests the once powerful U.S. industrial base has been eroding for sometime and can no longer meet the production demands of war. This analysis traced U.S. industrial mobilization from 1916 to 1988. The objective of the research was to examine past industrial mobilizations to see what was successful and what was not in mobilizing the industrial base. What became readily apparent is mistakes have been repeated time and time again with regards to industrial mobilization.

Another objective of the research was to assess the capability of the current industrial base to mobilize. A Delphi survey was conducted in hopes that the participants, with their extensive experience and knowledge of the U.S. industrial base, could provide some insight into the present condition of the industrial base.

INDUSTRIAL MOBILIZATION 1916-1988

AN HISTORICAL ANALYSIS

I. Introduction

Scope and Justification

The industrial base of the United States has provided the foundation for the nation's economic welfare and national defense. To fully appreciate the importance of the industrial base, as it applies to mobilization, requires an understanding of some of the history of the industrial base, and the role it has played in support of national defense.

England's Industrial Revolution began around 1760 when water and later steam were employed as power sources in the textile industry thus eliminating handspinning. The development of large-scale production methods increased the importance of industry in a National economy. These ideas migrated to the New World Colonies where there was an abundance of resources to support expansion of technique and output (51:134).

Eli Whitney, inventor of the cotton gin, introduced the concept of machine tool technology to the United States. The idea was based on the principle of "division of labor" developed by economist Adam Smith. Whitney believed the manufacturing process could be simplified by dividing the process into a series of simple operations, which would allow

each task to be performed by unskilled or semi-skilled workers working to exacting drawings and specifications. This approach to manufacturing marked a departure from the traditional, and slower, process which relied on craftsmen to perform all the tasks required to produce a product from raw materials (21:34).

Whitney further refined this approach to manufacturing with what he called the "uniformity system". He described his objective this way, "My aim is to make every part of a complex mechanism, such as a clock or a musket, as much alike as successive impressions from a steel engraving" (21:34). This concept remains still today the basis for mass production.

Prior to the War of 1812, the United States could not provide the necessary weapons to support the growing demands of the regular army and the state militias. President Washington signed bills establishing national armories at Springfield, Massachusetts, and Harpers Ferry Virginia, in 1794. However, the arsenal at Springfield managed to produce only 2,111 muskets by the beginning of 1798 and the arsenal at Harpers Ferry did not produce its first weapon until 1801 (53:24). Both armories were using only the "craftsman" approach to weapon production.

The Congress appropriated \$800,000 in 1798 for purchasing weapons from private contractors. This legislation placed arms making in the industrial sector. Twenty-seven contracts were awarded to parties who were to deliver 40,200 muskets during the spring of 1798. None of the manufacturers involved

were required to verify their ability as gunsmiths or their ability to fulfill the contract on time (53:24-6).

By June 1801, nearly nine months after the due date, only three of the original twenty-seven contracts had been filled. Some manufacturers defaulted on their contract, while others could not produce the weapons fast enough to meet the contract deadline. Eli Whitney represents the most famous of those contracted who was unable to meet his contract deadline.

Whitney signed a contract on 14 June 1798 for 10,000 stands of arms. A stand of arms consisted of a musket, bayonet, ramrod, wiper, oil can, and a screwdriver. At the time he signed the contract Whitney was in financial difficulty and had neither the facility nor the trained people available to manufacture the weapons he had contracted to produce. As the deadline approached, Whitney realized he was not close to being able to fulfill his part of the contract. He went to the capital taking with him enough finished pieces to assemble 10 muskets. Whitney impressed President Jefferson with his concept of the "uniformity system" as he demonstrated how a musket could be produced by interchangeable parts. Jefferson realized the importance of Whitney's concept for the production of domestic weapons and recommended he be granted an extension. Although it took till 23 January 1809, nearly eleven years, for Whitney to fulfill his contract the venture was considered a success. Jefferson declared Whitney's factory a "national asset" and soldiers in the field said Whitney's muskets were the best they had ever seen (21) (53).

The mass production technique was the driving force behind the industrialization of the United States. Manufacturing industries such as textile, steel, transportation, and wood benefited from Eli Whitney's idea. Mass production techniques became the norm for many industries which produced items for civilian consumption, as well as for military use. Additionally, the mass process reduced unit cost and increased the availability of many items to almost everyone in America.

Radical changes were taking place within many industries in the United States as the industrialization fever spread. An illustration of this was the birth of what we now call the machine tool industry. Amos Whitney, a relative of Eli, believing machine tools themselves could be mass produced, formed a partnership with Francis Pratt and founded the Pratt and Whitney Company, which became the foundation of a blossoming tooling industry and later aviation production capacity (21).

By the time the Mexican War broke out in 1846 a sound industrial base was emerging. New machinery for manufacturing weapons made it possible for the Springfield armory to produce 14,200 muskets and the Harpers Ferry armory to produce 12,000 muskets during the period of 1 July 1846 until 30 June 1847. Private contractors were able to meet the demands of the war and manufacturing began to take on a bigger role in American society and our National economy (1:27).

The Civil War, 1861-1865, tested the country's young industrial base, as it had not yet been tested. The Army Ordnance Department was responsible to supply the forces of the North fighting to preserve the Union. Because Confederate forces had stripped the machinery from, and then set fire to, the arsenal at Harpers Ferry in the spring of 1861, the North sought to gain additional weapons from Europe to augment those being supplied by the arsenal at Springfield. The North continued to purchase arms from Europe throughout the war. The arsenal at Springfield was expanded and as early as January 1862 was producing 10,000 rifles a month, which exceeded the arsenal's entire annual production of 1860. By the end of the war the arsenal produced 815,139 pieces while private manufacturers contributed over 1.5 million small arms (53:34).

After the end of the Civil War, Congress quickly went to work disassembling the nation's wartime military forces. The strength of the army diminished from more than a million men to 57,000 men in less than a year. War Department appropriations met a similar fate as they went from \$1 billion in 1865 to \$57.7 million in 1870 (53:35). These actions were omens of what was to occur several times more in our war history.

The firearms industry suffered serious hardships during this period as ordnance disbursements were reduced by nearly 87 percent. For all intents and purposes the government canceled the contract systems. Only eleven of the forty-eight

major arms contractors involved in the Civil War remained active after 1870. Government owned plants were hardest hit by the postwar era. The Springfield arsenal which had made worthy contributions in the area of mechanized factory production was no longer on the edge of technological change, due largely to the ability of the machine tool industry to respond and, as a result, no longer tried to be innovative in the manufacturing of weapons.

The consequences of dismantling the military and its supporting industries surfaced during the Spanish-American War of 1898. The United States was far behind Europe in the development of military technology. According to one author:

The three most important developments of the age-magazine rifles, breech-loading steel artillery, and smokeless propellents-were only just beginning to be produced in large quantities at government arsenals and were not widely distributed among American troops until after the fighting had ended. Only regulars, for example, were issued new .30 caliber Krag-Jorgenson bolt-action rifles. The great majority of volunteers-some 200,000 strong-carried single-shot, black-powder Springfields, an arm which dated back to the late 1860s (53:39).

The lack of funding, along with public indifference, plagued the U.S. military and its support industries between 1865 and 1914.

Government and industry relations began to change with the recognition that economic preparedness was critical to the future success of U.S. military forces on the battlefield. A basic policy was developed which had private manufacturers supplying the Army, while the Army operated its own factories to assist in establishing standards and to train its officers in the field of acquisition (1:56).

The United States has mobilized its industrial base, in the interest of national defense, three times during this century: World War I, World War II, and the Korean War. The production of the industrial base was so staggering in World War II that defense related production increased from two-percent of the gross national product (GNP) in 1940 to forty-four percent by 1944. The United States became known as the "Arsenal of Democracy" and the military supplier to the free world. There has been growing concern from a number of sources, ranging from Congressional investigations to private studies, about the current state of the industrial base and its capability to provide adequate support in the event of mobilization. One of the most well known reports is the "Ichord Report", a 1980 report by the House Armed Services Committee. The report warned "the defense industrial base has deteriorated and is in danger if further deterioration" (60:1). A more recent report is the 1988 Air Force Association's report, "Lifeline in Danger". The report by the Air Force Association concludes, "American industry today is unable to expand its production to meet wartime mobilization needs in less than eighteen months" (58:i). Industrial readiness, as history has shown, is vital to national security and accurate assessment of the capabilities of the industrial base is critical.

Specific Research Problem

This research examined industrial mobilization of the United States from 1916 to 1988. The purpose of the study was

to identify elements which proved to be successful in past attempts to mobilize the industrial base and to answer the questions: What planning factors contribute to effective industrial mobilizations? and How did the current (1988-1989) U.S. industrial base stand in relation to these factors?

Investigative Questions

The following investigative questions were explored in an attempt to answer the research problem.

1. What were the lessons learned from previous industrial mobilizations, and were they being considered in current industrial mobilization planning?
2. What was the effect of more complex weaponry, due to technology, on the ability of the industrial base to respond if mobilized?
3. What were the critical resources (raw materials, manpower, etc.) needed to support industrial mobilization; was there an adequate supply of each; and have they been stockpiled?
4. What were the relationships between the national defense budget and the ability of the industrial base to mobilize?

Scope

The time constraints of my graduate education program made it impractical to attempt to review all the literature concerning U.S. industrial mobilization during the period examined. The research considered only those issues thought to directly impact the capability of the U.S. industrial base to mobilize. The literature review included material from the

Defense Technical Information Center (DTIC); Air Force Institute of Technology (AFIT), the Wright State University, and Ohio State University libraries, USAF Historical Research Center; as well as information gathered from various publications (Government Accounting Office (GAO) reports, Air Force Association, Congressional reports, etc.).

Definitions

The following important terms are defined:

Defense Industrial Base: The industrial base from which, in a national emergency, we will require the capability to rapidly produce large numbers of technologically sophisticated weapons and spare parts (20:11).

Industrial Mobilization: The process of preparing and controlling industry to meet the unprecedented demands of modern war for munitions and military supply of all kinds (34:6).

Mobilization: The conversion of the commercial economy to wartime production (37:14).

National Security: A collective term encompassing both National Defense and Foreign relations of the United States (19).

Production: The conversion of raw materials into products and/or components thereof, through a series of manufacturing processes. It includes functions such as production engineering, controlling, quality assurance, and the determination of resources requirements (19).

Resources: Something which readily available for use when needed.

Surge: The first acceleration of production from peacetime rates, without disruption of commercial work (37:14).

The National Economy: Elements such as the Agricultural Base, Service Base, Extractive Base, etc. that provide the United States with its source of wealth.

Methodology

This research project relied heavily upon historical research techniques to answer the research questions posed earlier. Historical research has been defined as:

The systematic and objective location, evaluation, and synthesis of evidence in order to establish facts and draw conclusions concerning past events. . . the essential steps of historical research are defining the problem, gathering an accurate account of the subject investigated, and evaluating and synthesizing the data into an accurate account of the subject investigated. . . the review of literature actually provides the research data (9:261).

The evaluation of historical evidence is usually referred to as historical criticism" (9:264). There are two problems often associated with historical criticism. First, maintaining rigor or avoiding external criticism by ensuring the sources located are authentic, and, secondly, maintaining objectivity or avoiding the biases and distortions that define internal criticism (9:264-5).

Specific Methodology. The research used a two-step approach:

Step 1. The researcher performed an extensive literature review relating to industrial mobilization of the United States from 1916-1988. The purpose of the literature review was to closely examine the history of industrial

mobilization to develop a comprehensive list of factors found important during past mobilizations.

Step 2. Information gathered from the literature review was used to build a survey using the Delphi technique. The purpose of the survey was to add rigor to the research and to evaluate the capabilities of the current industrial base. The Delphi method was employed in hopes of benefiting from the experience of experts in the field of industrial mobilization.

The Delphi technique provides a means to formulate opinion-based concepts. Opinion has been defined by an anonymous source as the "area between knowledge and speculation; it is based on judgement, wisdom, and insight" (17:2). The Delphi method is a technique used to isolate individuals and gather their responses to prepared questionnaires. The responses are then summarized and submitted to the individuals again. The process is repeated until consensus or convergence of opinion occurs (17:6).

The Delphi method was selected for this research in part because it seeks to eliminate some of the disadvantages of the face-to-face decision making process. One such disadvantage is the pressure for individuals to conform to the opinion of the group. Another disadvantage is that in many instances dominant individuals, who may not have the best ideas, shape the opinion of the group (18:14).

The Delphi method attempts to eliminate the disadvantages of face-to-face decision making by soliciting individual answers. The responses of the group members are summarized

and those outside a specified range may be asked to explain their responses in the next round of questioning.

Participants are provided the opportunity to express their opinions, as well as challenge the opinions of the other participants (17:4). This method of providing the participants feedback is geared to having them consider factors they may not have considered before or had previously dismissed (10:3). The goal of this iterative approach is convergence of opinion. There has been criticisms of the Delphi technique for its lack of rigor. H. Sackman concluded from his review of 150 Delphi studies that statistical significance of Delphi results were rarely reported. In many instances the questionnaire items did not sample all the key elements of the subject under study and, as a result, exhibited a lack of validity (50:13).

Additionally, Sackman criticized the use of experts in the Delphi Method "... The use of experts as the principle and exclusive method for validating tests has been disqualified" (50:16). Sackman believed that in order for the use of experts to be valid the experience and qualifications should be documented in the research being performed (50:19).

Sackman also criticized the Delphi method for creating an environment which encourages snap judgements. He suggested soliciting and encouraging detailed responses and criticisms of other participants' remarks in order to discourage snap judgements (50:22).

Sackman warned about the Delphi method's inherent pressure to obtain group consensus. In order to not have to answer another round of questions participants may agree with the group response (50:47-9).

The objective of the Delphi technique is to reach consensus on an issue. This procedure might take several rounds of questioning to accomplish the goal. The time constraints of this study dictated the questioning be limited to two rounds. Consensus for the purpose of this study was set at 70 percent agreement. Likert scale responses, "highly agree/agree" and "highly disagree/disagree" responses were grouped together for determining whether or not consensus was reached.

The results from the first round of questioning were tabulated and the mean responses computed for each item. The responses were examined for consensus and the second round of the Delphi survey was based on these results. Items on which consensus was reached were not repeated in the second round. However, feedback on the consensus items was provided to the participants of the survey in the form of the percentage of participants which agreed or disagreed to a given question.

The second round of questions were based on the non-consensus questions from the first round of the Delphi survey. Each participant was provided with his response to each non-consensus item as well as the group mean or modal response. Each participant was then given the opportunity to answer the

non-consensus questions again. A copy of the second round survey is shown in Appendix C.

Included in the second round Delphi survey were comments made by the participants in the first round. Each topic section of the second round survey began with related general comments made by the participants from the first round. The intent of placing the comments at the beginning of each topic was to encourage the participants to read and consider the comments before answering the second round questions. Participants were encouraged to express their opinions about the comments of the other members taking part in the survey. A listing of first round comments is shown in Appendix B.

Summary

This chapter presented an overview of the previous of the importance of the United States industrial base to national security, and suggests that examination of previous industrial mobilization efforts of the U.S. might yield factors that could prove useful in assessing the current capabilities of the U.S. industrial base. The methodology was presented and consisted of historical criticism and the Delphi technique.

Chapter II is an overview of literature concerned with U.S. industrial mobilization during the period of 1916-1988. Chapter III presents the findings of the Delphi survey and Chapter IV answers the investigative questions and makes recommendations for further research.

II. Literature Review

This chapter reviews literature concerning industrial mobilization of the United States during the period 1916-1988. The format is chronological and traced the successes and failures of U.S. industrial mobilization efforts. The intent of the review was to gather historical examples of industrial mobilization efforts.

World War I

World War I marked the first time our nation totally mobilized for war. Prior to this, industrial capacity played a small part in equipping U.S. military forces. The weapons produced were for the individual soldier, mostly rifles and pistols. However, World War I introduced a new level of sophistication and technology through an array of new weapons such as: submarines, aircraft, tanks, updated field artillery, motorized vehicles, radio, and other such items. The technology needed for the new weaponry called for greater participation of industry. Because the weapons relied heavily upon steel, petroleum, and rubber, those industries were pushed to the forefront of our economy. For the first time in U.S. history, military power was completely reliant on a responsive and sustaining industrial base (34:21).

Although the formal United States declaration of war came on 6 April 1917, World War I actually began on 28 June 1914 with the assassination of Austrian Archduke Ferdinand by a

Serbian. United States involvement began years before its declaration of war, with the selling of war materials to the Entente Powers (Great Britain, France, and Russia) to help in their continuing struggle with Germany and members of the Central Powers.

Initially it was believed by most Americans the U.S. would not be drawn into the war. However, as the war raged on in Europe the idea of American involvement became more than a remote possibility. As a result, interest in the nation's preparedness began to build. Henry Breckinridge, former Assistant Secretary of War, called for a larger Army and more training for the Reserves in his book entitled Preparedness published in 1916 (28:35). Not only was there interest in the mobility of people, but in the mobility of industry as well. Howard E. Coffin, a member of the Naval Consulting Board, noted:

. . . twentieth century warfare demands that the blood of the soldier must be mingled with from three to five parts of sweat of the men, the factories, mills, mines, and fields of the nation in arms (28:36).

The growing concern with preparedness resulted in the formation of a Committee on Industrial Preparedness, which came under the control of the Naval Consulting Board. The purpose of the Committee was to examine the ability of industry to support any future conflicts involving the United States (28:44). The Committee's investigation led it to believe the country was not prepared to engage in a war.

In August 1916 the United States made a commitment toward a rational mobilization policy. President Wilson ordered

Congress to "create the right instruments by which to mobilize economic resources in time of national necessity" (28:37).

Congress responded and on 29 August 1916 the Council of National Defense was created. Members of the Council included the Secretaries of War, Navy, Interior, Agriculture, Commerce, and Labor. The President outlined the Council's functions as follows:

1. The coordination of all transportation and the development of means of transportation to meet the military, industrial, and commercial needs of the nation.
2. The extension of the industrial mobilization work of the Committee on Industrial Preparedness of the Naval Consulting Board to complete information as to how our present manufacturing and producing facilities will be procured, analyzed, and made use of (12:22).

In addition the President added the following tasking:

One of the objectives of the Council will be to inform American manufacturers as to the part they can and must play in a national emergency. It is empowered to establish at once and maintain through subordinate-bodies of specially qualified persons an auxiliary organization composed of men of the best creative and administrative capacity, capable of mobilizing to the utmost the resources of the country (12:22).

The Council of National Defense, acting under the guidance given, established the National Defense Advisory Commission (NDAC), a committee of seven individuals selected for their expert knowledge. Individuals named to the Advisory Commission represented some of the nation's most prominent figures, They were: Bernard Baruch, financier; Howard E. Coffin, Vice President of the Hudson Motor Company; Dr. Hollis Godfrey, President of Drexel Institute; Samuel Gompers, President of the American Federation of Labor; Dr. Franklin Martin, Secretary-General of the American College of Surgeons,

Julius Rosenwald, President of Sears Roebuck and Company; and Daniel Willard, President of the Baltimore and Ohio Railroad.

The NDAC was charged with the "coordination of industries and resources for the national security and welfare" (13:25). The first meeting of the Advisory Commission took place on 7 December 1918 and marked the beginning of plans to mobilize the U.S. should the need arise. In July 1919 a report to Congress on Expenditures in the War Department by Congressman William J. Graham, stated:

. . . examination discloses that a commission of seven men, chosen by the President, seem to have devised the entire system of purchasing war supplies, planned a press censor-ship, designed a system of food control, determined on a daylight savings scheme, and in a word designed practically every war measure which the Congress subsequently enacted, and did all this behind closed doors weeks and even months before the Congress of the United States declared war on Germany . . . far as I can observe, there was not an act of the so-called war legislation afterwards enacted that had not before the actual declaration of war been discussed and settled upon by the Advisory Commission . . . (13:25).

The United States was not very successful in carrying out the NADC's plans. Although the U.S. brought a well established industrial base into the war, it was centered around the production of civilian goods. The biggest war-support problem the U.S. faced was the transformation of the industrial base from production of consumer goods to production of military items (16:21). The late entry of the U.S. into the war should have provided the advantage of building a U.S. industrial base capable of completely supporting our military forces. However, this was not the case. England's wartime premier, David Lloyd George commented:

It is one of the inexplicable paradoxes of history, that the greatest machine-producing nation on earth failed to turn out the mechanism of war after 18 months of sweating and toiling and hustling. . . There were no braver or more fearless men in any Army, but the organization at home and behind the lines was not worthy of the reputation which American business men have deservedly won for smartness, promptitude and efficiency (11:37-8).

General John J. Pershing made the following observations concerning the shortage of tanks:

It seems strange that, with American genius for manufacturing from iron and steel, we should almost find ourselves after a year and a half of war almost completely without those mechanical contrivances which had exercised such a great influence on the western front in reducing infantry losses (11:38).

Further illustration of the inability of U.S. industry to support the war effort was clearly shown when:

As mobilization began in 1917, the government ordered 50,000 pieces of artillery, along with the requisite stocks of ammunition, from U.S. industry at a cost of \$4 billion. Of these, only 143 pieces were finished in time to be used on the battlefield (58:6).

During the early months of the war it became obvious that the U.S. lacked an overall plan. As a result, the country stumbled through the early part of the war creating various emergency agencies: The Food Administration, The Fuel Administration, Railroad's War Board, Exports Council, and others. Another problem that plagued the U.S. production effort was the tendency to concentrate procurement orders in the northeastern portion of the country. Mr. Bernard Baruch wrote in Industrial America in the World War, that:

Each (Government bureau) sought those plants whose manufacturing facilities promised the best results as judged from experience in normal times. This procedure had a tendency to localize orders in the northeastern manufacturing district of the country, and congestion soon began to appear, with inevitable slowing up of

deliveries. By the Fall of 1917 many plants had orders far beyond their available capacity. Fuel and raw materials could not be transported in sufficient quantities to supply the plants. The spring of 1918 saw the great manufacturing center north of the Potomac and east of the Alleghenies completely congested. . . several other parts of the country were not engaged in war work to any important extent and in many instances the peace time business was declining (33:319).

The problem of congestion was also experienced in the transportation industry. Problems with the railroads began before the entry of the U.S. into the war. The orders placed by the Allies led to unprecedented transportation demands and, in December 1916, the United States became a victim of the worst railway congestion the nation had ever seen. Poor management of freight cars was the primary cause of the problem. While in some locations the lack of freight cars caused mills to shut down, other areas had so many cars that movement was at a standstill. An illustration of the problem was New York, where congestion became so bad the port of New York was nearly closed off (33:342).

The entry of the U.S. into the war put additional stress on the already burdened U.S. railroads. In December 1917 there were 200 ships in New York harbor awaiting cargoes and fuel while 44,320 railroad cars of freight headed for Europe were backed up as far west as Buffalo and Pittsburgh (33:343).

Historians have offered several items that may have contributed to the paralysis of the U.S. rail and shipping industries during late December of 1917. The factors cited include: unusually heavy snowfalls, colder than normal temperatures, abnormal amount of traffic flowing to ports on

the East Coast, mounting labor shortages, and a shortage of coal, as demand from growing war industries; railroads, and shipping outran the supply (2).

The railroad industry, in addition to the problems mentioned above, had a history of over regulation that dated back to 1907. Decisions made by the Interstate Commerce Commission and state agencies tended to favor the shippers rather than the railroads. As a result, the railroads lost revenue which in turn caused a reduction in the railroads' return on investment. The railroads, finding investment capital hard to come by, drastically reduced spending on new equipment and maintenance by almost 70 percent between 1911 and 1916 (2:101-4).

The Railroads War Board, a five-man committee, was created in 1916 in an attempt to obtain cooperation from the privately owned railroads in such areas as the sharing of equipment. Efforts made by the Railroads War Board were unsuccessful due to failure of individual railroads to live up to agreements and the pressure from the unions for higher wages. The growing transportation dilemma caused President Wilson to issue a proclamation on 26 December 1917 giving the government possession and control of the railroads. The following is a statement issued by the President concerning the government's seizure of the railroads:

This is a war of resources no less than of men, and it is necessary for the complete mobilization of our resources that the transportation systems of the country should be organized and employed under a single authority and a simplified method of coordination which have not proved possible under private management and control (33:344).

The actions taken by the President to seize control of the railroads paid almost immediate dividends. Shipments of freight to military posts went from a low of 118,752 tons in January 1918 to a peak of 809,774 tons in November 1918. While government intervention improved the transportation problem, transportation remained a major bottleneck to production throughout the war. An illustration of this is the time required to deliver 75-mm. artillery shells. Even during the height of the war effort it took twice as long to transport the shells as it did to manufacture them (33:345).

Shortages of labor, and a variety of essential materials, compounded the inability of the U.S. industrial base to respond in a timely manner. While the war brought industrial growth to the U.S. (See Table 1), and an increased demand for labor, it also greatly reduced a traditional source of workers. Immigration to the United States dropped from 1.2 million in 1914 to 110,000 in 1918, and as a result American industry scrambled to find workers to "man the machines".

The high demand for labor caused fierce competition for workers among U.S. industries, which in turn resulted in rapid turnover of the workforce. Some cities reported labor turnover at 100 percent per week. One cotton mill in Charlotte, North Carolina reported:

There is a general shortage of labor in all lines of industry, and this has created a very keen competition for labor so that employers are constantly bidding for each others' labor. This has created a much larger than usual moving element, and there are a great many employees who have worked in many different mills during the past year (70:91).

Table 1.
Indices of Industrial Production, 1914-1918
(1914=100) (2:92)

Activity	1914	1915	1916	1917	1918
Industrial Materials					

All Commodities	100	110	127	132	127
Ferrous Metals	100	137	182	192	189
Textiles	100	111	124	127	123
Processed Food	100	103	111	110	118
Physical Production					

Mining	100	109	126	133	134
Manufacturing	100	117	139	138	137
Railroads	100	107	124	136	142

On 18 May 1917 Congress passed the Selective Service Act to draft men to serve in the military. Draft boards were established and every man between the ages of twenty-one and thirty-one was required to register or face a year in jail. While the Selective Service Act provided troops for the American Expeditionary Force (AEF), the U.S. military force sent to Europe, it also took away a large segment of the labor force. It has been estimated that 16 percent of the male labor force was drafted into one of the military services (2:95). The effect of this drain on manpower created serious problems for industry. For example The American Tool Works in Cincinnati, where 99 percent of the work was war related, cited delays in production because of the "loss of many of our skilled employees through voluntary enlistment and the draft" (70:91).

Labor requirements during the war opened industrial employment to women and minorities. Occupations which once belonged to white males, such as skilled positions in the railroads were often filled by blacks and women. Many blacks migrated from the rural south to the north to find jobs in foundries, steel mills, construction, and a variety of other industries.

Shortages of labor and its distribution caused the government to take action. In January 1918 the United States Employment Service (USES) was established as an independent agency within the Labor Department. The purpose of the USES was to serve as a central pool of unskilled laborers. The President requested, in June of 1918, that all employers engaged in war related work get their unskilled employees through the USES. The USES registered, between January and November of 1918, 3.6 million workers and placed 2.6 million of them. However, industry was in need of some 7.8 million workers, a number they never found throughout the course of the war (70:92).

The migration of workers to the industrial centers caused the population of those cities to grow at alarming rates (See Table 2). In Akron, Ohio, the tire manufacturing center of America, the population increased sixty thousand between 1915 and 1919. The rapid increase of people created a housing shortage that persisted throughout the war. In Akron at the end of the war it was estimated there were still twelve thousand more families than houses. The housing shortage,

not unique to Akron, was the case in many of the cities throughout the United States (70:112).

Table 2.
Population of Selected Cities 1910-1920
(70:112)

<u>City</u>	<u>1910</u>	<u>Increase</u>	<u>1920</u>
New York	4,800,000	18%	5,600,000
Chicago	2,200,000	23%	2,700,000
Philadelphia	1,500,000	18%	1,800,000
Detroit	465,766	113%	993,678
Los Angeles	319,198	81%	576,673
Chester (Pa.)	38,537	51%	58,030
Seattle	237,194	33%	315,312
Akron (OH.)	69,067	202%	208,435
Gary (Ind.) ,	18,802	229%	55,378
Bridgeport	102,054	41%	143,555

The Editor of the *Journal of the American Institute of Architects*, Charles Harris Whitaker, wrote an article in the *New York Times* which proposed government intervention to assist with the housing shortage. He stated that "no adequate means of relief is possible unless government funds are made available" (70:117). Mr. Whitaker went on to present an outline for federal government involvement in the problem. His article declared "industrial organization is the key to the duration of the war. The key to industrial organization is proper living conditions" (70:118).

In May 1918 Congress established the United States Housing Corporation. The Housing Corporation built six thousand homes and a number of dormitories in some eighty cities. The end of the war brought an abrupt halt to the construction program.

According to one author the Housing Corporation made a significant contribution to the war effort. He wrote:

for the first time in our national history an effort has been made to deal with industrial community life in accordance with a carefully planned and liberal-minded policy. True, any general social purposes. . . were largely subordinated to the object in view-the prosecution of the war; but it is this very fact which gives the government's policy its real significance. The war has emphasized as never before the vital relation of decent living conditions to production. . . (70:119).

Raw materials such as steel, iron, aluminum, petroleum, coal, coke, nitrogen, rubber, manganese, tungsten, and others, became essential due to the array of new weaponry introduced in World War I. The United States is blessed with a variety of natural resources including coal, petroleum, copper, and wood, to name but a few. However, even with the nation's wealth of natural resources, U.S. industry experienced shortages of various essential materials throughout the war. Some of the shortages occurred because the United States did not possess the material in sufficient quantities to meet the demand, or because production methods to recover the material had not been developed. As one author states:

During the war the country was constantly threatened with a shortage in available supply of nitrogen, manganese, chrome, tungsten, dyestuffs, coal-tar derivatives, and several other essential materials. These materials had always been imported in to the United States and their production never developed, although sources for most of them exist here (5:103).

Other shortages occurred because suppliers of the material could not keep up with the demand. Such was the case with aluminum. The Aluminum Co. of America, the sole U.S. producer, could not meet production needs for both war and civilian

requirements. A partial list of essential materials in short supply in the U.S. during the war is shown in Table 3.

Table 3.
Essential U.S. WW I Materials Shortage
(5:109-304)

<u>Material</u>	<u>Main Use</u>	<u>Main Source</u>
Manganese	used in steel production	U.S./Brazil
Vanadium	cutting-tool steels	Peru
Tungsten	high-speed tool steels	U.S./Far East
Chromite	armor plate, machine tools	U.S./S. Malay
Tin	tin plate for containers	Africa
Aluminum	engine castings	U.S.
Nitrate of soda	munitions	Chile
Brass	used for cartridge cases	U.S.
Wool	clothing, blankets	Europe
Artificial dyes	coloring cloth	Europe

It became obvious in the early stages of the war that there was no overall plan for industrial mobilization and, as a result, agencies were created to cope with problems as they occurred. Over 5,000 mobilization agencies were created, to oversee some facet of the U.S. economy, within one year after the United States declared war (2:102).

The controlling function for industrial mobilization during the war evolved from the Council of National Defense (CND). The War Industries Board (WIB) was created by the CND three months after the U.S. entered the war and given the task of developing plans for allocating priorities and increasing production as required throughout the industrial sector. The WIB represents the first centralized agency in U.S. history responsible for integration of economic mobilization and military mobilization (51:320).

Initially the WIB attempted to reach its objectives through voluntary cooperation of private industry but, as the war progressed and demand for supplies grew, it became apparent the voluntary approach was inadequate to meet the needs. President Wilson, responding to requests from the WIB and others to take action, endorsed the Overman Act on 20 May 1918. The Overman Act gave the President the authority to coordinate or consolidate agencies in the interest of economy and for more efficient concentration of government. The President, using the authority given him, removed the WIB from under the jurisdiction of the CND and made it an administrative agency reporting directly to him. President Wilson appointed Mr. Bernard Baruch as Chairman of the War Industries Board and in a letter to Mr. Baruch, dated 4 March 1918, the President outlined the functions of the WIB. They were as follows:

1. The creation of new facilities and the disclosing, if necessary, the opening up of new or additional sources of supply;
2. The conversion of existing facilities, where necessary, to new uses;
3. The studious conversion of resources and facilities by scientific, commercial, and industrial economies;
4. Advice to the several purchasing agencies when the supply of that article is insufficient, either temporarily or permanently;
5. The determination, wherever necessary, of priorities of production and of delivery and of proportions of any given article to be made immediately accessible to the several purchasing agencies when the supply of that article is insufficient, either temporarily or permanently;
6. The making of purchases for the Allies (5:24).

The operating structure of the WIB consisted of approximately sixty commodity areas and six functional divisions: Conservation; Priorities; Price-Fixing;

Requirements; Labor; and Allied Purchasing. Each commodity area was headed by a civilian expert. A unique thing about the WIB's civilian experts is that they were volunteers who donated their services as public officials. The experts provided knowledge and made recommendations; made contact with the industries; and with the purchasing agents, and directed the enforcement of regulations and control (1:65) (5:109). In addition to the civilian membership, each commodity committee had at least one Army or Navy officer assigned. The reorganization of the WIB marked the start of a long-term partnership between government and industry for the sake of national security.

While the WIB certainly improved the situation, problems and shortages still plagued the U.S. production effort. Labor remained a major problem throughout the war. The latter part of the nineteenth century saw the growth of labor unions in the United States as workers began to organize themselves.

Two labor unions were prominent in the United States during World War I. The American Federation of Labor (AFL) and the Industrial Workers of the World (IWW). AFL leadership, headed by Samuel Gompers of the NADC, promised the support of the AFL during the war and in March 1917 issued the following statement:

we . . . offer our services to our country in every field of activity to defend, safeguard, and preserve the Republic of the United States of America. . . and we call upon our fellow citizens. . . to devotedly and patriotically give like service (70:95).

The IWW on the other hand was led by primarily socialists opposed to the war. While the ideologies of the two unions may have been different, the membership of both unions were being affected by the mounting wartime inflation. Prices of goods were rising faster than wages due to the billions of dollars being spent in the U.S. for war supplies by the Allies. Disillusioned with the government and union leadership, many workers made the decision to strike (See Table 4). The areas

Table 4.
U.S. Strikes 1915-1919
(2:99)

<u>Year</u>	<u>(#) Strikes</u>	<u>(#) Workers</u>
1915	1,248	468,983
1916	3,678	1,546,428
1917	4,233	1,193,867
1918	3,181	1,192,418
1919	3,253	3,950,411

west of the Mississippi were particularly affected by the strikes. Influences of the IWW were often cited as the reason for the strikes. Industries affected because of strikes included copper, lumber, and communications.

One author states:

A miners' strike that centered on Arizona, the world's largest copper-producing area, threatened the production of shells, bullets, detonators, and cable, while strikes in the forests of Washington, Oregon, and California halted the supply of spruce essential for aircraft manufacture. Strikes in various oilfields reduced fuel supplies, and disputes in the Chicago meat-packing industry held up the canning of food for the army (70:97).

Determining requirements posed problems for the WIB on a number of occasions. The production of aircraft caused

particular problems. As of April 1917 the U.S. Army had a total of fifty-five airplanes, all of which were outdated. Furthermore, there were only sixty-five men qualified to fly an airplane. The Secretary of War, Nathan D. Baker, believed the airplane could make a major contribution to the Allied war effort. He asked Congress for \$800 million dollars for the "greatest air fleet ever devised" (23:110). President Wilson approved the plan and the wheels were set in motion.

The initial plan, at the time of the U.S. entry into the war, called for 2,500 planes to be built. Representatives from England, Italy, and France reported to the Wilson administration they would require some 25,000 aircraft from the United States (55). An order of that magnitude would require the expansion of production facilities tenfold. Production problems began to appear almost immediately. An airframe required as much as 5,000 feet of lumber to get the required 500 feet of wood with no cross or spiral grain. Wood without cross or spiral grain was needed to help provide structural integrity for the airframe. Flax, a linen thread used for sewing leather and canvas, was required in quantities of 250 to 500 yards per airframe. The U.S. imported most of its flax from Ireland and found it impossible to obtain throughout the war. It took valuable time for the U.S. to develop a suitable substitute.

Secretary Baker saw the 20,000 aircraft he promised the Allies fall dramatically, as the figure dropped to 17,000, 15,000, 2,000, and finally settled at 37. Of the 8,364

aircraft used by the U.S. Army in France, most were foreign built (See Table 5) (23:112).

Another illustration of poor requirements planning involved the procurement of powder for the Army. The powder was used to make of ammunition and other forms of munitions. As such, it was essential. The Army did not place any additional orders for powder at the start of the war because it was not envisioned that the U.S. would send a large contingency to Europe. The major maker of powder in the U.S. was E.I. du Pont de Nemours and Company. It was not until October 1917 that the Army realized it needed to place additional orders for powder. To accommodate both the Allied and U.S. requirements for powder required new production facilities to be built.

The Army negotiated a deal with Du Pont worth \$250 million, \$90 million for the new plant, and \$155 million in initial orders. Secretary Baker cancelled what would have been the largest government contract in U.S. history. Investigations into the terms of the contract revealed the new plant was to be completely government subsidized and that Du Pont would receive in the neighborhood of \$30 million a year in profits. Secretary Baker and President Wilson were both of the opinion that Du Pont was making excessive profits at the expense of the war.

In a meeting with Pierre du Pont, Secretary Baker stated that "I have just come from the White House. I may tell you we have made up our minds we are going to win this war without Du Pont" (23:115). The government decided to build and own its

powder plant, forgetting that Du Pont was the only company in the U.S. which knew how to efficiently construct and operate a powder plant. It took four months for the government to realize it needed the expertise of Du Pont and for Du Pont to agree to another government contract to build the new powder plant (23:113-15).

The inability of American industry to respond in a timely manner resulted in Allied, not American, production being largely responsible for supplying the AEF (See Table 5). However, the industrial might of the United States did have a considerable impact on the war's outcome. The affect the was summed up by Bernard Baruch, the Chairman of the WIB:

When fighting ceased, war production in the United States was reaching its peak. Every unit of the vast machinery was keyed up to high speed. There is no doubt but that knowledge of this fact contributed materially to Germany's sudden realization of the hopelessness of her position (54:38).

German Chief of Staff, Field Marshal Paul von Hindenburg paid tribute to the U.S. industrial mobilization effort saying:

Her brilliant, if pitiless, war industry had entered the service of patriotism and had not failed it. Under the compulsion of military necessity a ruthless autocracy was at work and rightly, even in this land at the portals of which the Statue of Liberty flashes its blinding light across the seas. They understood war (54:38).

Another industry not able to meet the war demands was shipbuilding industry. Although the industry made a gallant attempt to fulfill the promise of a "Bridge of Ships" to France (39:130), it was not able to do so in time to make a big impact on the lack of ocean transportation. That is not to say that the shipbuilding industry did not produce an amazing amount of

ships. Had the war continued the contribution of the industry would have been substantial (23:98-102). The rate at which the industry grew was staggering:

In April 1917 the entire United States contained 37 yards with 142 ways for steel vessels and 24 yards with 73 ways for wooden vessels. These yards employed 45,000 workers. In subsequent months the board spent \$270 million and built 341 yards with a total of 1,284 ways, more than double the ways in the rest of the world. By the end of the war American yards employed 380,000 workers (23:99).

Prior to World War I ships were built by craftsmen, one ship at time. However, the mass production techniques pioneered by Henry Ford for automobiles were adopted and in 1918, "American shipyards built 533 ships, over three-million tons, setting a world's record for one year's production" (39:131).

One of the biggest problems which slowed the shipbuilding industry during the early phases of the war was a dispute over authority. The clash was between William Denman, head of the Shipping Board, and Maj. Gen. George Goethals, head of the Emergency Fleet Corporation. The Emergency Fleet Corporation was a government owned agency responsible for building and operating ships. The major difference between the two men was Gen. Goethals wanted his agency to be independent of the Shipping Board as opposed to being the Shipping Board's operating subsidiary. It was not until after the resignation of both men, in July 1917, that the shipbuilding program began to gather steam (23:100-01). The incident serves to illustrate the impact individuals can have on mobilization.

Table 5.
Equipment furnished the American Expeditionary Force (AEF)
(between 8 April 1917 and 11 November 1918)
(33:334)

<u>Type</u>	<u>Total</u>	<u>From France</u>	<u>From England</u>	<u>From U.S.</u>
Artillery	4,194	3,532	160	502
Howitzer, 9.2 in.	40	0	40	0
8-in.	208	0	120	88
155-mm.	798	796	0	2
Gun, 10-in.	15	0	0	15
8-in.	6	0	0	6
6-in.	74	0	0	74
155-mm.	233	233	0	0
5-in.	26	0	0	26
4.7-in.	71	0	0	71
75-mm.	2,002	1,862	0	160
37-mm.	701	641	0	60
Railroad Artillery	158	140	0	18
Howitzer, 400-mm.	4	4	0	0
Gun, 14-in.	84	66	0	18
340-mm.	2	2	0	0
32-cm.	12	12	0	0
24-cm.	24	24	0	0
19-cm.	32	32	0	0
Caissons	9,023	2,638	0	6,365
Howitzer, 155-mm.	1,994	796	0	1,198
Gun, 4.7-in.	219	0	0	219
75-mm.	6,810	1,862	0	4,948
Trench mortars	2,555	237	1,427	891
Mortar, 240-mm.	101	101	0	0
8-in.	1,757	0	14	843
6-in.	561	0	513	48
58-mm.	138	136	0	0
Automatic weapons	124,352	40,484	0	83,868
Browning mach. gun	30,089	0	0	30,089
Vickers mach. gun	10,411	0	0	10,411
Hotchkins mach. gun	5,255	5,255	0	0
Browning rifle	43,368	0	0	43,368
Chauchat mach. rifle				
8-mm.	15,988	15,988	0	0
.30-cal.	19,241	19,241	0	0
Tanks	289	227	26	36
Renault	237	227	0	10
Mark V and VI	24	0	12	12
Airplanes	6,345	4,874	258	1,213
Balloons	295	20	0	
Horses	225,598	136,114	21,759	67,725

While mobilization of the U.S. industrial sector was not as successful as it might have been, the mobilization of troops proved very successful. As a result of the Selective Service Act of May 1917, the first of the U.S. draftees were ordered to report to training camps in September 1917. The government built thirty-eight camps throughout the U.S., each with the capacity to support 40,000 men. The life of the draftee was not easy. It began at 5:30 in the morning with reveille and ended at ten o'clock at night with taps. The days were filled with "learning the skills of soldiering". Although there was a shortage of weapons in the training camps, due to shipments of weapons to the Allies, in addition to the inability of industry to respond to demands, training continued.

In some artillery units recruits trained with telegraph-poles using them to simulate artillery. Thousands of infantrymen drilled with wooden guns because of the scarcity of rifles, which meant in certain divisions over half the men were deployed to Europe having never fired a rifle. Rocks served as grenades for many a recruit during the course of his training. In spite of the shortage of weapons, the first 500,000 draftees were completing their training by the winter of 1917.

The first "Doughboys", as the American soldiers became known because of the white clay dust that covered the troops in the Southwest during the Indian wars, arrived in France on 27 June 1917. Fourteen-thousand men of the Army's First Division, along with a regiment of U.S. Marines marked the beginning of the flood of American troops that were to cross

the Atlantic during World War I (39). Bernard Baruch commented on the ability of the U.S. to mobilize troops. He stated:

The speed with which our Army grew from 200,000 to 4,000,000 men, and the success with which it was being moved to Europe at the rate of 225,000 troops per month during the summer of 1918, were phenomena which amazed not only our enemies but our allies (13:29).

The sheer logistics of supplying a force that size was not an easy task. It was estimated that each U.S. soldier required around 20.25 pounds of supplies daily in order to perform his mission. A U.S. infantry division had 29,000 men during World War I, which means 725,000 pounds of supplies were needed daily to keep one division fully operational. General Pershing, Commander of the AEF, established the Services of Supply (SOS), a rear detachment equal in size to the front line forces, to accomplish the feat.

Each Doughboy was issued a pack (See Table 6) that more or less made him a self-contained fighting unit. The packs were heavy, weighing fifty pounds or more, and uncomfortable.

Table 6.
Contents of a World War I Doughboy pack
(39:78)

<u>Items</u>	
heavy overcoat	woolen cap
shirts	waterproof groundsheet
sweater	blanket
socks	bandages
comb	gas mask
toothbrush	rifle, cover, bayonet, pistol
mess kit	150-200 rounds of ammunition
shaving supplies	hand grenades
canteen	shovel
towel	extra boots

Lessons Learned - World War I

The United States was not prepared for World War I. Much of the American population was sure the war in Europe would never come. Most people thought it impossible. However, the war did come and it quickly became evident the U.S. had not planned for the industrial mobilization required to support the war effort.

Noted historian, George Lincoln, cited six lessons the nation should learn from the industrial mobilization of World War I. They were as follows:

1. Such wars require a total economic effort.
2. A war economy requires government control.
3. Careful allocation and adjustment is necessary to prevent shortages of critical items.
4. Economic interdependence with allies is inevitable.
5. The numbers and complexity of modern weapons require long lead time and expensive preparations.
6. Prior provisions of stores are necessary to support combat until new systems can be produced (29:5).

Mr. Lincoln believes the U.S. did not reap the knowledge it gained during World War I. He stated: "the principles demonstrated by World War I were generally lost sight of, disregarded, or even violated". His final conclusion was: "we did not learn very well" (39:5).

Bernard Baruch, Chairman of the WIB during the war, listed three factors concerning industrial preparedness gained from the war. They were:

1. There should be a peace-time skeleton organization following the lines of the War Industries Board.
2. During the war the U.S. government was constantly threatened with a shortage of critical resources. The government should provide for their internal production.

3. Under the supervision of the government, certain war industries should be encouraged to maintain skeleton organizations (5:102-07).

The recommendations made by Mr. Baruch were largely ignored as the U.S. moved into the post war years, a mistake which cost the nation during the next war.

World War I changed the face of warfare forever with its introduction of a host of technologically sophisticated weapons. The importance of the material side of modern warfare came to the forefront. Martin Van Creveld, distinguished military historian, addressed the change in the nature of war in World War I. He wrote:

The products of the machine-bullets, shells, fuel, sophisticated engineering materials-had finally superseded those of the field as the main items consumed by armies, with the result that warfare, this time shackled by immense networks of tangled umbilical cords, froze and turned into a process of mutual slaughter on a scale so vast as to stagger the imagination (1983)

No longer could the U.S. expect to fight a war without taking into consideration the necessary lead time to manufacture the weapons of war. This point is highly relevant to current U.S. mobilization plans. Technology in warfare brings with it trade-offs in terms of the time it takes to mobilize.

World War I clearly showed the ability of the U.S. industrial base, given enough time, to produce war materials if called upon (See Table 7). Expansion of the industrial base during the war was unprecedented up to that time. The extent to which the industrial base can be diverted from the production of civilian goods to that of war materials depends

largely on the mood of the civilian population and the ability of the government to convince its citizens of the need for the production of war materials to support whatever conflict the U.S. might be engaged in.

Table 7.
War Output as a Percentage of Gross National Product
(Constant Prices) (3:42)

	<u>1914</u>	<u>1915</u>	<u>1916</u>	<u>1917</u>	<u>1918</u>
World War I	0.8 %	0.8%	1.0%	9.4%	23.3%

Post World War I

The signing of the armistice on 11 November 1918 stopped the expansion of the great industrial machine of the U.S.. The demands of war faded, and the joys of peace prevailed, as the nation rushed to "get the boys home by Christmas". Demobilization, the return to peace time status of the Army, occurred without much thought given to the consequences of the rapid return of some 4,000,000 men on the U.S. economy. President Wilson, invited to address the Reconstruction Congress of American Industries, after the signing of the Armistice, sent this reply:

You may be sure that I would send a message to the meeting in Atlantic City if I knew what message to send, but frankly I do not. It is a time when we must all thankfully take counsel and apply the wisest action to circumstances as they arise (51:333).

The President's reply clearly indicates that U.S. leadership did not have an overall strategy for demobilization.

The Army decided to demobilize by unit with the thought in mind that this approach would preserve the needed manpower to continue the Army's day-to-day operations. The first troops discharged were some 600,000 stationed in the United States. They were the first to be released because the AEF had to be returned home before its manpower could be discharged.

It was the spring and summer of 1919 before most of the 2,000,000 men assigned to the AEF could be returned. The lack of vessels, Allied ships were withdrawn from U.S. service after the signing of the Armistice, was the reason for the delay. All possible ships were converted to troop carriers, including cargo transports, battleships, cruisers, and even ten enemy ships.

During the war around 100,000 troops a month were transported across the Atlantic. The 174 vessels gathered for the return of the AEF represented a troop fleet four times larger than the one the U.S. possessed on Armistice Day. The troop transport fleet had a single-lift capacity of 419,000 men. The 368,000 troops returned during June 1919 was 60,000 more than was ever sent to Europe in one month during the war (33:392).

In addition to military demobilization, there was the matter of industrial demobilization as well. The war ended sooner than many people expected, including some government officials. The Secretary of the Interior, Frank Lane, expected the war to continue until 1920, while the Postmaster General thought it would last until 1921, and still others believed the

war would last until the mid-1920s (70:97). The point is that no one had thought out a plan for the demobilization of industry.

At the time of the signing of the Armistice there were approximately 30,000 War Department contracts outstanding. The dilemma was how to handle the situation without causing problems for the economy. While some contracts contained termination clauses and could be easily handled, many of the outstanding contracts were without such clauses and presented a problem. Although it was possible for the War Department to simply cancel all outstanding contracts, this action would have been counter-productive for all parties concerned.

Congress passed the Dent Law on 2 March 1919 to help with the negotiation process between industry and government. Under the Dent Law the Secretary of War was given the authority to settle all contracts.

The Comptroller of the Treasury, after the signing of the Armistice, issued a policy which disallowed payment of contractors for unfinished work unless they had legal documentation of their contract agreement with the government. The ruling by the Treasury department caused two problems. First, it did not allow payment to those contractors who had written contracts considered invalid due to some documentation error and, secondly, it did not allow payment to those contractors who never had a formal contract but began production on a verbal agreement. It was because of problems such as these that the Dent Law was enacted.

The process for the settlement of what the Treasury had deemed invalid contracts was accomplished under the Dent Law by dividing the contracts into two categories, those with written documentation, and those without written documentation.

The procedure for the written contracts was the same as if the contract had been declared valid. The final approval for honoring the contract was given by the War Claims Board. The procedure for verbal contracts was handled differently. The Board of Contract Adjustment was responsible for hearing the testimony involved with these contracts and when agreement terms were reached, either issued the award, or transferred the contract to the proper agency for settlement. Approximately 7,000 claims were filed and evaluated under the terms of the Dent Law (33:394).

Converting the industrial base back to peace time status involved the following considerations: the impact on the economy; additional production, if desired, to contribute to reserves; and how facilities and machinery should be maintained for industrial reserve. The conversion of the industrial base followed the general guidelines which allowed for completion of most items in work, planned for the tapering-off of production in most plant, and held some facilities in reserve (33:394).

The recommendations made at the conclusion of World War I by the WIB that some skeleton staffs be continued, that domestic sources of key materials be developed, and a small munitions industry be maintained were rejected because they were not in line with the political climate of the time. The

first and foremost concern of the government was trying to control the cost of living.

In 1919 the cost of living was 77 percent higher than in 1914, and 102 percent higher by 1920. The problem was one of too many dollars chasing too few goods. This was primarily caused by the inability of the economy to expand to meet consumer demand.

While the cost of living was soaring, production of goods was creeping. In the third quarter of 1918 production was only 17 percent higher than in 1914, and was only 19 percent higher by the third quarter of 1919. By late 1920 the trouble peaked when the average index number of wholesale prices for typical commodities collapsed, dropping from 154.4 in 1920 to 97.6 in 1921, marking the beginning of a depression in the U.S. that would last until 1923.

The depression brought massive unemployment as over 5 million, or 12 percent, of the country's labor force were without jobs. The people who were fortunate enough to have a job saw their wages greatly reduced. The average hourly wage reported by the National Industrial Conference Board was 62.1 cents in 1920 fell to 48.2 cents by December 1921 (51:334).

The decade following World War I saw little progress in mobilization planning in the United States. The controlling structures of the U.S. war effort were quickly dismantled at the conclusion of the war, as the country embraced the "return to normalcy" platform of Warren Harding during the 1920

presidential campaign. One piece of legislation that did address mobilization was passed by Congress on 4 June 1920.

The National Defense Act of 1920 was passed in an attempt to incorporate some of the lessons learned from World War I into peace-time mobilization planning. Under the National Defense Act, industrial preparedness became the responsibility of the Assistant Secretary of War. His charter was:

supervision of the procurement of all military supplies and other business of the War Department pertaining thereto and the assurance of adequate provision for the mobilization of material and industrial organizations essential to war needs (25:6).

There was acknowledgment by U.S. leadership of the importance of preparedness. President Harding in a 1923 address in Seattle stated:

. . . today we saw the Pacific Fleet. . . equal to the first in all the world. . . our navy shall retain that first rank, and any failure must be charged to ourselves. . . let us hope that our Congress, with the cordial sanction of the American people, will continue that first rank (56:478).

However, there was little funding allocated in the Federal Budget for preparedness purposes. Although there was a lack of economic support for mobilization planning, and overall progress was slight, there were some noteworthy accomplishments made during the 1920s. The creation of the Army-Navy Munitions Board in 1922, which made industrial mobilization a joint concern, was one such accomplishment. There were two other achievements worthy of mention, the establishment of the Army Planning Branch, and the founding in 1924 of the Army Industrial College.

The Army Planning Branch became responsible for developing plans for wartime procurement and industrial mobilization, while the Army Industrial College was established to provide training for selected Army, Navy and Marine Corps officers in the aspects of economic mobilization. Officers selected for the program, which took one year to complete, became full-time students of mobilization planning. The school was a success and would make valuable contributions to future mobilization planning (33).

There was another event in the 1920's that was to have long range implications in every aspect of American life: The Great Depression of 1929. The crash of the stock market, on what became known as "Black Thursday", happened on 24 October 1929 and signaled the end of an economic boom in the United States, and marked the beginning of economic strife for most of the civilized world.

After the post war depression of 1920 the U.S. economy made major advancements beginning in 1923. Unemployment fell to 3.2 percent of the labor force, and productivity increased for the remainder of the decade for most industries (See Table 8).

A feeling of euphoria spread across the nation as investors poured money into the stock market. Investors in the speculative market included people from all walks of American life. Widows, teachers, factory workers, wall-street financiers, all risked their savings to make a "killing" in the market. Herbert Hoover, in the Presidential campaign of 1928

predicted, "We shall soon with the help of God be in sight of the day when poverty will be banished from this nation" (41:939). There were those who predicted the stock market crash of 1929. Rodger W. Babson predicted on 5 September 1929, "There is a crash coming, and it may be a terrific one, involving even a decline of from 60 to 80 points in the Dow-Jones barometer" (41:939). However, those predicting the crash were regarded as "doomsayers" and after the crash occurred were even blamed for causing the crash.

Table 8.
Economic Expansion (1920-1929)
(51:335)

<u>Year</u>	<u>Industrial Production</u> <u>(1913 = 100)</u>	<u>Gross National</u> <u>Product (1913 \$)</u>
1920	124.0	\$ 42.6
1921	100.1	40.7
1922	125.9	43.7
1923	144.4	49.7
1924	137.7	50.7
1925	153.0	52.4
1926	163.1	55.8
1927	164.5	56.3
1928	171.8	57.1
1929	188.3	60.9

On 24 October 1929 13 million shares of stock changed hands, as investors scrambled to sell their stock. The market began a downward slide that would hit bottom in mid-1932. Table 9 illustrates, using a sample of common stocks, the affect of the stock market crash on the prices of stock. The industrial sector was not alone in the devastation created by the stock market crash; the agricultural industry was also severely affected (See Table 10).

Table 9.
Prices of Common Stocks (per share)
(41:940)

<u>Stock</u>	<u>1929 (high)</u>	<u>1932 (low)</u>
AT&T	310.25	69.75
General Electric	403.00	8.50
General Motors	91.75	7.60
National Cash Register	148.75	6.25
Remington Rand	57.75	1.00
Sears and Roebuck	181.00	9.80
United States Steel	261.75	21.25

Causes for the collapse of the U.S. economy were many, and included over production of goods, over extension of credit, and laissez-faire economic policies. Severe unemployment followed on the heels of the nation's economic collapse. Jobs virtually disappeared overnight as thousands of businesses failed, thus leaving millions of people without the means to earn a living. It has been estimated that 13 million, or about one-fourth of the labor force was out of work in 1933 (51:357).

Table 10.
Wholesale Prices of Selected Commodities
(annual averages to nearest half-cent)
(41:940)

<u>Commodity</u>	<u>1929</u>	<u>1930</u>	<u>1931</u>	<u>1932</u>
Wheat, bushel	\$1.035	\$0.67	\$0.40	\$0.38
Corn, bushel	0.80	0.60	0.32	0.315
Raw cotton, lb.	0.19	0.135	0.085	0.065
Wool, lb.	0.985	0.785	0.62	0.48
Tobacco, lb.	0.185	0.13	0.08	0.105

The economic woes of the country also affected the ability of the United States to prepare for future conflict. Money

became very tight during the early 1930s and, as a result, Congress funded very low annual budgets for military affairs, electing instead to fund social programs to help those hard hit by the depression.

Military strength was greatly reduced following World War I. After all, it had been called the "the war to end all wars". War was not a consideration in the minds of most Americans and from the state of preparedness, or lack of it, the government was in obvious agreement. No new major weapons were funded and the military had to rely heavily on surplus from World War I and hope the masses were right in their beliefs about U.S. involvement in a war.

Although little was accomplished in the way of mobilization planning during this time period (1925-1930), there was one piece of work that deserves mentioning. The Industrial Mobilization Plan (IMP) of 1930 was authored by the War Planning Branch, at the direction of the Assistant Secretary of War. It marked the first comprehensive mobilization plan for industry since the conclusion of World War I.

The Army-Navy Board eventually became the sponsor of the IMP and revised editions appeared in 1933, 1936, and 1939. The IMP attempted to use lessons learned from World War I to provide governmental and administrative procedures for industrial mobilization support for an Army of 4,000,000 men. In the IMP of 1939 changes were included that called for the centralization of power and the establishment of the War

Resources Administration to oversee the organizations of War Trade, War Labor, War Finance, and Price control. The plan also provided for commodity committees similar to the one used in World War I. The Director of the War Resources Administration would report directly to the President as an advisor on industrial mobilization issues. It was not envisioned that the War Resources Administration would be a standing agency but that it would be established as early as possible in the event of an emergency. The IMP would be implemented upon declaration of the emergency. Congress failed on several occasions to pass the necessary legislation required to implement the IMP fearing the military would gain too much power (13:29-35) (58:7).

While some progress was being made in the area of mobilization planning, the support of the general public was lacking. Fueling the public's lack of support was the "merchants-of-death" theory, popularized in a best selling book by the same name published in the mid-1930s by authors Helmuth Englebrecht and Frank Hanighen. According to the theory, was an international munitions industry that conspired to control whole nations through Government officials for the purpose of maximizing profits at the expense of human lives. The premise of the theory was that to overcome the loss of revenue in peace time the so-called international munitions industry would agitate and stir up hostile feelings between certain nations thus providing a market for the munitions industry (53:93).

If the merchants-of-death theory was fueling the fire of the public's anti-military sentiments, then undoubtedly the Congressional investigations by Senator Nye, examining some of the business transactions between the military and the industrial sector for alleged profiteering during World War I, were fanning the flames. Senator Nye initiated his investigation intent on proving the munitions industry and the banks were responsible for the U.S. involvement in World War I and responsible for all wars in general. His plan was to sponsor legislation to accomplish two things. First, he wanted to see the U.S. munitions industry outlawed and, secondly, he wanted to legally prevent U.S. participation in future wars.

The investigations lasted nearly two years, from the fall of 1934 to the spring of 1936, and were centered around uncovering "unethical conduct" by the munitions industry and the banks involved in World War I. The findings of the Nye Committee placed the blame for U.S. intervention in World War I squarely on the shoulders of the domestic munitions industry and the banking establishment. The final report went on to name companies, such as DuPont, and conclude that their profit motive was the driving factor behind U.S. involvement in World War I (53:101).

The general public, having been "educated" about the causes of war, began demanding Congress take action to correct the situation. The result was the passage of the Neutrality Act of 1935 which made it illegal for the United States to

provide financial support or munitions to any country engaged in war. The law was later amended by the War Policy Act of 1937 to provide the President some discretionary authority. However, it strongly restated the U.S. policy which forbade the sale of war materials to belligerent nations. World events would soon dictate unexpected changes to the U.S. policy of isolationism.

World War II

The feelings of the American people were changing in the final years of the 1930s. The country, although still recovering from the depression, had turned the corner under the leadership of President Roosevelt. While economic concerns were still in the forefront of most minds other issues were starting to be considered as the results of a poll conducted in April 1939 by the American Institute of Public Opinion clearly indicate. The poll asked, "What do you regard as the most important problem before the American people today? The replies indicated two major concerns: (1) lack of jobs and (2) possibility of war (47:10).

The concerns about the possibility of war were certainly warranted given the conditions in the world. Japan had openly displayed aggressive tendencies in the Far East by moving its military forces into Manchuria. In Europe, Germany, although restricted by the conditions of the 1918 Armistice, began to freely express its intent to rebuild its military forces. However, it was the German invasion of Poland on 1 September

1939 that made the American public realize the potential for U.S. involvement in the war was very high.

Sides for the war were quickly drawn as England and France, along with India, South Africa, Australia, New Zealand, and Canada declared war on Germany thus marking the beginning of World War II. President Roosevelt declared a limited national emergency and called for additional manning for the Army and the National Guard. Due primarily to public sentiment and small military budgets, the strength of the U.S. military by the middle of 1939 had been reduced to a total standing force of 334,473 men with an additional 200,000 men in the National Guard. Of the standing force of 334,473 men, 189,839 were in the Army, 125,202 were in the Navy, and 19,432 were in the Marines. The President gave the authorization for the Army's manpower to increase to 227,000 and the National Guard's to 235,000 (47:10).

The U.S., in addition to the problem of having an inadequate standing force, was also faced with the problem of outdated weaponry. General George C. Marshall, Chief of Staff of the Army, reported on the condition of the Army in 1939. He wrote:

Within the United States we had no field Army. There existed the mere framework of about three and one-half square divisions approximately fifty percent complete as to personnel and scattered among a number of Army Posts. There was such a shortage in motor transportation that divisional training was impractical. . . . Our equipment, modern at the conclusion of the World War, was now in a large measure obsolescent. In fact, during the postwar period, continuous paring of appropriations had reduced the Army virtually to the status of that of a third-rate power (40:16).

The Army was so poorly equipped that in September 1939 it possessed only about 10 percent of the required 75-mm. cannons and one percent of its 37-mm. guns. Although the President took action to increase the troop strength, nothing was done at this point about the lack of weapons (47:10). It became more obvious with each passing day that the U.S. would inevitably be drawn into the war. Congress reacted by increasing the military budget in preparation for what was to come.

The U.S. industrial base, although far from being prepared to meet future demands, had not been completely idle during the post-war years. The National Defense Act of 1920 made it desirable to establish industrial-ordnance districts, although the concept evolved from a similar arrangement used in World War I. The plan called for the U.S. to be divided into 13 Ordnance Districts (See Figure 1) to "establish and maintain a close working relationship with industry and to determine just what potential war production capacity existed in case a need arose" (11:18). Although budget restrictions after World War I (See Table 11) greatly hampered the Ordnance Department, they accomplished some significant planning toward future industrial mobilization.

The Ordnance Department determined war production capabilities of industrial plants by conducting industrial surveys. Records were kept of what the company manufactured, the types of processes involved, and a list of the company's equipment. It was not uncommon for a gentleman's agreement to be made between an industry and the Ordnance Department

regarding specified quantities and production rates to be met should the industry be called upon to do so. Included in the survey were procedures to help determine how a company would produce ordnance items that might be unfamiliar to the company. Included were such things as plant design, machine tool requirements, gages, raw materials, labor, and power (11:20).

Table 11.
 Ordnance Department Annual Budget (1925-1938)
 (as a percentage of the War Department) (11:20)

<u>Year</u>	<u>Ordnance Department</u>	<u>War Department</u>	<u>Percentage</u>
1920	\$20,805,634.79	\$813,304,262.20	2.55
1921	22,880,186.06	495,122,339.55	4.62
1922	13,425,960.00	373,109,831.22	3.59
1923	6,859,030.00	270,184,805.19	2.52
1924	5,812,180.00	256,669,118.00	2.26
1925	7,751,272.00	260,246,731.67	2.97
1926	7,543,802.00	260,757,250.00	2.89
1927	9,549,827.00	270,872,055.16	3.52
1928	12,179,856.00	300,781,710.93	4.04
1929	12,549,877.00	317,378,294.00	3.95
1930	11,858,981.00	331,748,443.50	3.57
1931	12,422,466.00	347,379,178.61	3.57
1932	11,121,567.00	335,505,965.00	3.31
1933	11,588,737.00	299,933,920.00	3.86
1934	7,048,455.00	277,126,281.00	2.54
1935	11,049,829.00	263,640,736.00	4.19
1936	17,110,301.00	312,235,811.00	5.47
1937	18,376,606.00	394,047,936.33	4.66
1938	24,949,075.00	415,508,009.94	6.00

The industrial surveys remained the Ordnance Department's primary function until June of 1938, more than a year before the German invasion of Poland, when Congress authorized the Secretary of War to place "Educational Orders". L. A. Codd, an Army Reserve Major, described them in an address at Princeton University 12 January 1937:

. . . the purpose of these orders being to allow the manufacturer to produce occasionally in time of peace a small quantity of military equipment for our Army so that plant personnel by actual experience are familiar with the engineering and production difficulties involved. Thus far, the Congress has refused to authorize educational orders (14:21).

The state of affairs in Europe caused Congress to change their minds shortly after the above address was given.

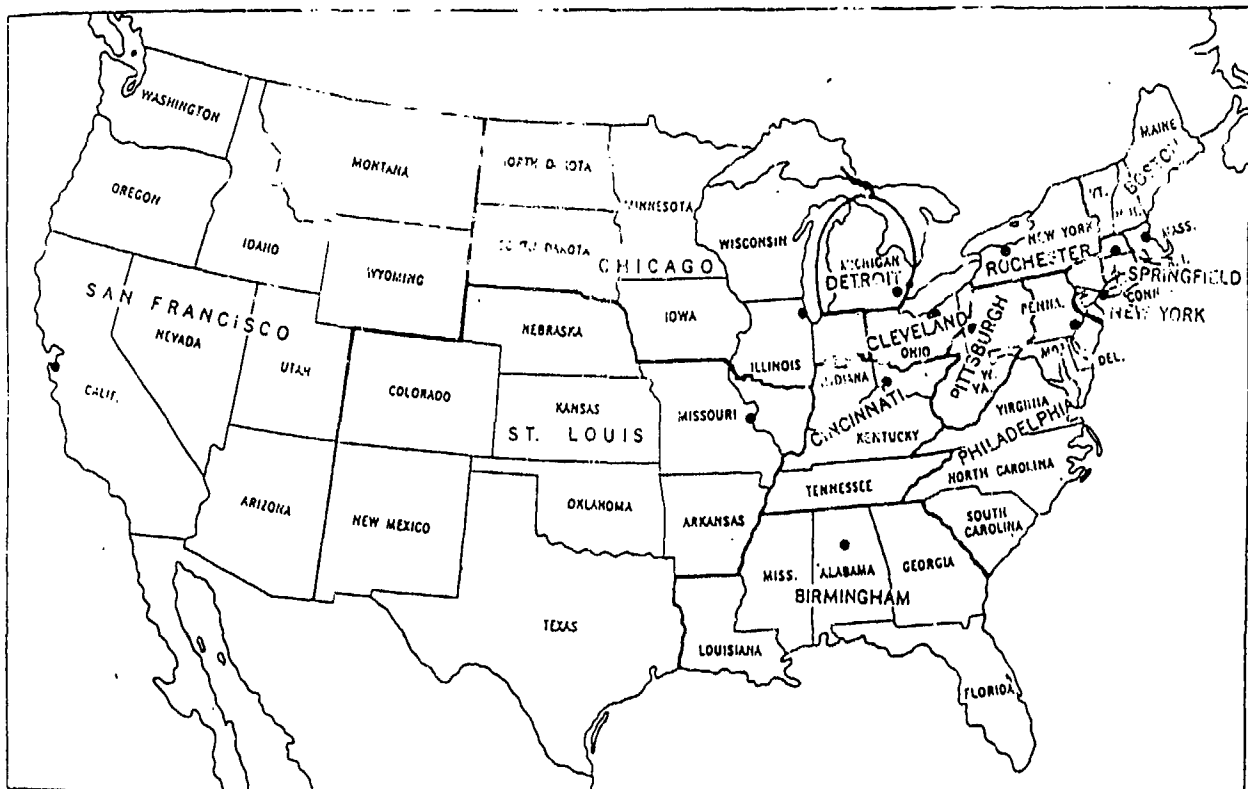


Figure 1. The Thirteen Ordnance Districts (11:19)

The previous discussion described the state of U.S. industrial mobilization preparedness leading up to World War II. At the outbreak of the war Allied countries began placing orders for military items with U.S. manufacturers, but

were limited to what they could receive due to U.S. neutrality laws. It soon became obvious the war was not going well for the Allies and that they needed stronger support from the U.S.. On 4 November 1939, after repeated requests by the President, the Congress relented and passed a revised Neutrality Act. The updated Act contained what became known as the "cash and carry" amendments which allowed the United States to sell arms to any country providing the country paid cash for the weapons and the arms were moved from the U.S. on the buyer's ships. England and France established offices in the U.S. to coordinate their cash and carry orders. However, waging war was and, still is an expensive proposition and, as a result, the English and French soon were unable to purchase the weapons they needed from the United States because they had no further cash. The U.S. restricted by law could not offer any further assistance to either country.

The United States by this time had begun preparations to arm itself. Although Congress had rejected the plan to immediately implement the Industrial Mobilization Plan upon the President's declaration of an emergency, in August 1939 President Roosevelt revived the country's war making capabilities with the appointment of the War Resources Board. The Board reviewed the IMP and gave its approval for implementation. However, the President, bowing to public pressure, rejected the War Resources Board's recommendation to implement the IMP.

The President, after rejecting the Board's recommendation, called upon the services of Bernard Baruch and John Hancock, former Secretary of the Navy to prepare a modified IMP (33:409). The revised IMP was more flexible in that it called for industrial mobilization to be accomplished in stages that included planning, transition, and war making. Under the original IMP full mobilization was to occur on the first day of the war, which was designated as M-day. Baruch and Hancock, with their experience from World War I, realized the idea of total industrial mobilization on the first day of the war was an unrealistic expectation. The two men made other significant modifications to the IMP including doing away with the War Resources Administration, the central controlling agency for industrial mobilization, in favor of decentralized control through several agencies under the control of the President as opposed to the War Department. The revised IMP met the approval of the President although he did not immediately seek to implement it (33:409-10).

In the spring of 1940 the situation was grave in Europe as German forces employing a highly effective tactic known as "blitzkrieg", or lightning war, were very successful. The strategy called for a swift and overwhelming attack on the enemy providing little time for their forces to respond. The spring of 1940 found the English and French forces trapped by the Germans at Dunkirk along the Northwest coast of France. It appeared though certain disaster was imminent as some half-million Allied troops faced either death or surrender. The

British conducted a daring evacuation of the Allied forces besieged in Dunkirk. In what was called "Operation Dynamo" the British, having a limited number of ships available, asked for volunteers owning any kind of watercraft to assist in the evacuation. Beginning 27 May 1939 over 900 boats of every description took part in the evacuation of Dunkirk. Although the loss of lives was estimated to be around 100,000, the remarkable rescue effort was responsible for saving the lives of some 340,000 troops (47:11-12).

The reality of war set in on the American people during the spring and summer of 1940. Most of Europe was under German control and Italy had invaded France and entered the war as a German ally. Now convinced the United States would be drawn into the war President Roosevelt took three significant steps toward preparing the U.S. for mobilization (13:36).

First, in May 1940, the President set up the Office of Emergency Management (OEM) within the Executive Office of the President to serve as the coordination link between his office, the Council of National Defense, and the National Defense Advisory Commission, both of which he resurrected in anticipation of mobilizing the U.S.

Second, the President requested Congress to take steps toward mobilization of the Nation's armed forces. In response to the President's request Congress in July 1940 agreed to double the existing Naval fleet, and in September granted the President the power to induct the National Guard and to call up the Reserves. To further enhance the ability of the country to

mobilize Congress, in September 1940, passed the first peacetime Selective Service Act.

The third step was taken when President Roosevelt in a speech at Charlottesville, Virginia, on 10 June 1940 served notice to the world of the United States intentions:

We will extend to the opponents of force the material resources of this nation; and at the same time we will harness and speed up the use of those resources in order that we ourselves in the Americas may have equipment and training equal to the task of any emergency and every defense (13:37).

This declaration of support of the Allies through supply of war materials was in direct opposition to the neutrality laws of the United States.

The British were in desperate need of assistance in the form of money or supplies but the neutrality laws made it illegal for the U.S. to come to their aid. President Roosevelt, along with the War Department, devised a plan to get around the Neutrality Act. The War Department declared certain military materials as surplus, even though in reality they were not, and available for sale to U.S. companies. The alleged surplus items, mostly rifles and artillery, were sold to U.S. Steel who then sold them to England in such a fashion as to undermine the Neutrality Act without being a violation of the law (47).

The President in July 1940 took further actions to prepare the U.S. for war. On 1 July he authorized the building of 45 Navy ships, and later that month signed the "Two Ocean Navy Expansion Act". The Act authorized additional ships and up to

15,000 aircraft. With each passing day the threat of war grew larger for the United States.

The Congress, in late summer of 1940, after inquiring about the U.S. capability to wage war found out what industrial mobilization planners had known for many years; the United States did not have the weapons it needed to arm its forces. The news should not have been a surprise to the Congress. General Marshall in February 1939 issued a statement to the Senate Military Affairs Committee which in part stated:

. . . it was of vital importance that we have modern equipment for the Regular Army and National Guard; that we modernize our artillery; that we replace our 34-year-old rifles with more modern weapons; that we have the antitank and antiaircraft material in the actual hands of the troops; that we have the necessary reserves of ammunition; and that these matters be emphatically regarded as fundamental to the entire proposition of national defense . . . (40:16).

However, Congress was shocked to find out that: some of the nation's coastal defense guns had not been fired in 20 years, the Army did not possess enough anti-aircraft guns to defend even one major U.S. city, and that the Army had virtually no tanks (47:14).

The British were all that stood between Germany and total dominance of Europe in the waning months of 1940. President Roosevelt made his desires known during a Fireside Chat on 29 December of 1940. His wishes were for the United States to aid Britain in her struggle against the Axis powers (Germany and Italy) and become the "arsenal of democracy" (47:20).

The Lend-Lease Act of 1941 was a result of President Roosevelt's Fireside Chat. Passage of the Act in March 1941

gave the President the authority to "...sell, transfer title to, exchange, lease, lend, or otherwise dispose of any defense article to any country whose defense the President deemed vital in the defense of the United States" (47:21). The passing of the law could not have come at a better time. Although the evacuation of Dunkirk was a major success in terms of saving lives, there was no means to evacuate the enormous amount of equipment and, as a result, more than 75,000 vehicles, 8,400 anti-tank weapons, 11,000 machine guns, 1,200 artillery pieces were left behind on the beaches (47:21).

The Lend-Lease Act provided the means for U.S. support of the free world. The following statement is one author's opinion of the importance of the Act. He states:

The decision was crucial in the emergence of America's "arsenal" role in the anti-Axis coalition. It firmly established foreign aid as an essential feature of the total strategy of rearmament, mobilization, hemisphere defense, and eventually victory in a global war (13:37).

In addition to providing the vehicle for U.S. support the Lend-Lease Act also accomplished the following:

1. The Act gave the U.S. an early start on the expansion of its wartime industrial base, and by the time we declared war production lead times had been greatly reduced.
2. It served to stimulate the U.S. economy and helped the country overcome the effects of the depression.
3. Because the weaponry was all U.S. made, the Allies and the U.S. had the advantage of using standardized equipment, which greatly reduced logistical problems.
4. It was responsible for the "Reverse Lend-Lease" which provided essential support of U.S. forces in other countries during the war (47:24).

While the United States was moving toward a mobilization posture from a policy standpoint, we had not yet realized the monumental task of the industrial conversion required to

support such a policy. Possession of the greatest industrial capacity on earth does not guarantee the strongest military force as well:

Military or immediate war-making potential is not merely strong economic potential. It is economic potential plus time, plus a willingness to convert from peace to wartime requirements. Had our frontiers adjoined those of Germany, it is certain that American industry, since it was geared to peacetime manufacture and lacked the protection of a well equipped army, would have been as powerless as Poland's industry to resist a blitzkrieg, 1939 style (45:36).

It is not enough to have a strong industrial base and a well trained military force, though at the time we did not have such a force, when faced with fighting a war. Raw materials are essential. They form the backbone for sustaining a country's war fighting capabilities. While the U.S. was better supplied than any other country with regards to major raw materials required to fight a 1940s war (For examples See Table 12), there were some raw materials the United States did not possess in superior amounts.

Table 12.
The Production of Three Major Raw Resources -- 1940
(45:38-9)

<u>Raw Material</u>	<u>Country</u>	<u>Production</u>
Pig Iron/net tons	United States	47 million
	Germany	23 million
	Russia	15 million
Steel/net tons	United States	67 million
	Russia	28 million
	United Kingdom	22 million
Petroleum/barrels	United States	1.3 billion
	Russia	212 million
	Venezuela	185 million
	Iran	79 million

One material the U.S. did not possess in sufficient quantity was rubber. Bernard Baruch issued a warning on 10 September 1942 concerning the importance of rubber to the Allied war effort. He concluded, "of all the critical and strategic materials, rubber is one which presents the greatest threat to the safety of our nation and the success of the Allied cause" (11:288). Virtually all of the world's rubber, except for a negligible amount, came from the Far East. In peace time the United States, with its giant automobile industry, accounted for the use of approximately one-half the world's rubber capacity. The uses for rubber included, tires, footgear, wires and cables, machinery, artillery, arms, ammunition, aircraft, tracked vehicles, and gas masks. In peacetime the U.S. annually consumed some 525,000 tons of rubber. It was readily apparent that requirements for rubber would greatly increase in time of war. In early 1940 it was estimated that if drawn into the war we would require 655,000 tons just to support our own defense needs, as well as those of the Allies (45:38). The outlook for the United States to get enough rubber to meet the anticipated demand was slim at the beginning of 1940, even though Congress had passed legislation six months earlier to assist with the shortage of critical materials.

The Congress passed the Strategic Materials Act on 7 June 1939. The purpose was to authorize the appropriation of \$100 million over four years to purchase, move, and store stocks of strategic and critical materials (24:73). The Army-Navy

Munitions Board (ANMB) was tasked with determining what resources were considered "strategic" or "critical" to national defense (See Table 13). Strategic resources were defined as those "essential to national defense, for the supply of which in war dependence must be placed in whole, or in substantial part on sources outside the continental limits of the United States" (24:68). Critical resources, on the other hand, were defined as those "essential to national defense, the procurement problems of which in war would be less difficult than those of strategic minerals" (24:68).

Table 13.
Listing of Strategic and Critical Raw Materials
(24:68)

<u>Strategic</u>	<u>Critical</u>
Antimony	Aluminum
Chromium	Asbestos
Coconut shell char	Cork
Manganese, ferrograde	Graphite
Manilla fiber	Hides
Mercury	Iodine
Mica	Kapok
Nickel	Opium
Quartz crystal	Optical glass
Quinine	Phenol
Rubber	Platinum
Silk	Tanning material
Tin	Toulol
Tungsten	Vanadium
	Wool

While the Act had been passed, money appropriated, and strategic and critical materials identified, the actual stockpiling of materials got off to a slow start (See Table 14). Of the \$100 million appropriated only \$13 million had been

spent by May 1940 and by the end of the year it was clear it was not possible to import some of the identified materials in the amounts required. The lack of available shipping and the time it took to receive some of the materials made it necessary to examine development of domestic sources and the possible use of substitutes (24:74).

Table 14.
Stockpile Acquisitions of Strategic Raw Materials
(as of 28 December 1941) (24:75)

<u>Strategic material</u>	<u>Unit</u>	<u>Recommended amount</u>	<u>On hand</u>
Antimony	Short ton	18,000	2,351
Chromium	Long ton	870,000	79,957
Coconut shell char	Short ton	1,000	0
Manganese, ferrograde	Long ton	1,800,000	113,037
Manilla fiber	Bales	395,257	32,596
Mercury	Flasks	10,000	550
Mica	Pounds	7,000,000	0
Nickel	-----	None	-----
Quartz crystal	Pounds	108,900	20,476
Quinine	Oz.	8,400,000	1,123,280
Rubber	Long ton	388,393	105,279
Silk	1,000 lbs.	Not specified	3,911
Tin	Long ton	159,400	20,805
Tungsten	Short ton	13,000	6,927

Not only was there a very limited stockpile of critical materials, but the beginning of 1940 found military equipment so low in military units and U.S. arsenals that troops trained using wooden guns as rifles, towing telephone poles in place of artillery pieces, and using almost anything with four wheels as tanks (47). The condition of the munitions supply was just as devastating. There were only six government-owned and operated arsenals which had not been upgraded since World War I. The

production required by the Army during peacetime did not warrant civilian contracts. However, at the start of the war in Europe there was only one arsenal in the U.S. capable of manufacturing anything but small arms ammunition. As a result, it quickly became necessary to enlist civilian industry to help produce the artillery and munitions required for war. Even with the assistance of private industry it became obvious ordnance plants would have to be built to meet the demands for powder and explosives. Lt. General Levin H. Campell Jr., Chief of Ordnance, U.S. Army, 1942 to 1946, commented on the situation: "there were no industries that could be changed over. We had to build new and additional plants quickly to produce ammunition, the most critical of all critical items" (11:102). The government adopted a government-owned, contractor operated (GOCO) approach to the problem and by the end of the war there were 84 munitions plants in operation throughout the United States.

Although the machinery to rearm the United States was set in motion, the country was not prepared for war when the Japanese attacked our forces in Hawaii on 7 December 1941. However, the situation was not as grave as it could have been. Our industrial support of the Allied war effort had been underway for almost two years and we had built up a good foundation for the wartime industrial base by the time we were forced into the war. The attack on Pearl Harbor coalesced the public and focused the will of the nation to harness our resources for the purpose of full-scale mobilization (18) (1).

It was recognized early in the war that if the U.S. was going to be triumphant a partnership between industry and government was essential. This meant thousands of privately owned plants had to be rapidly converted to wartime production. The monumental task of converting an industrial base centered around the production of consumer goods to an industrial base focused on the production of war materials is what the U.S. faced during the early months of the war. According to one source:

contracts for millions of dollars worth of bombs, shells, small-arms ammunition, as well as tank and automotive equipment, were awarded to many companies which had no previous mass production experience (11:73).

The industrial transition from peacetime to wartime in one of the thirteen Ordnance Districts (See Table 15) will serve as an illustration of the accomplishments of American industry during the war.

Table 15.
The Industrial Growth of the
St. Louis Ordnance District (1940-1944) (11:73)

<u>Year</u>	<u># New Facilities</u>	<u># Expansions to existing facilities</u>
1940	78	207
1941	70	210
1943	29	98
1944	60	165

Examples of typical conversions which occurred within American industry during the war are as follows:

1. A metal weatherstrip manufacturer of St. Louis became a producer of 60-mm. mortar shell.

2. A mill manufacturing company of Beatrice, Neb., in prewar days manufacturers of windmills for waterpumping, eventually turned out 90-mm. high-explosive shell.
3. A manufacturer of Shelbyville, Ill., made arming wires for bombs instead of bobby pins and hair bows.
4. A manufacturing company of Warren, Ohio, used to make kitchen sinks and cabinets of pressed steel. In 1940 it received an Educational Order for 105-mm. cartridge cases. The company financed the installation of new machinery and began production in May, 1941. During the war the company produced millions of cartridge cases both in brass and steel (11:78).

The expansion of the industrial base was not a cheap proposition and required capital investment on the part of the private sector to make it a success. The government recognized that if expansion of the U.S. industrial base was to take place, incentives to invest in the expansion were necessary. One incentive for investment in industrial expansion which proved to be quite lucrative for private industry was the tax amortization law. Under the tax amortization law a company, whose facilities were expanded for the production of essential war goods, could depreciate the expansion at a rate of 20 percent a year versus the normal 5 percent to 10 percent per year. Thus a company could completely depreciate the expansion over a five-year period.

While the tax amortization law proved to be successful, it could not be counted on to fund all the required industrial expansion. The government took additional steps to encourage investment by the private sector. The Emergency Plant Facilities (EPF) contracts were developed to provide for government reimbursement by providing monthly payments over a five-year period to a company to cover the cost of expansion.

The company held the title to the facility until the full reimbursement had been paid by the government, at which time the government owned the facility. The company then had the option of buying the facility at cost less depreciation. EPF contracts were short lived because of problems of determining depreciation rates and troubles encountered meeting tax requirements. The Defense Plant Corporation contracts proved to be more successful. Set up in August 1940, the Defense Plant Corporation would enter into a contract with a company, once the Army or other government agency made a determination of need, and provide the company with the money for site acquisition and construction. The Defense Plant Corporation held the title and the company leased the facility for a token fee, something like a dollar a year, at the end of the emergency the company could purchase the facility at cost less rental payments, or cost less depreciation, whichever was higher. The Defense Plant Corporation advanced \$3 billion, of which over 80 percent went to expand facilities for aircraft production and related items (33: 456-7) (24:78-9). Of the \$3 billion allotted for facility expansion in 1940, \$1.6 billion was spent on military construction, \$3.7 billion went for industrial expansion, the remainder went for a variety of items such as, roads, and housing. An indication of how successful were the government incentives to invest in the industrial expansion is clearly indicated by the fact that of all the industrial expansion that took place during the last six-months of 1940, over 60 percent was privately financed (24:78).

Donald M. Nelson, Chairman of the War Production Board during the war, identified three categories of work that an economy must sustain during wartime. They are as follows:

1. Items of direct defense, materials of war which are used directly by the armies, such as aircraft, ships, guns, and ammunition. Orders for them are placed by the contracting officers of the Army, the Navy, and the Maritime Commission.
2. Products which are necessary for the maintenance of a civilian economy or for the production of war items. Orders for these items are not placed by contracting officers of the Army, the Navy, or the Maritime Commission, but by contractors or companies which engage in necessary services for the nation's basic economy; for example, railroad equipment, highway equipment, farm equipment, farm implements, machine tools, refinery equipment, mining machinery, repair parts, food, housing, clothing and so forth.
3. Items which do not fall into the first two classes, but which are bought when they are available by the civilian population and which are considered to be luxuries or semi-luxuries; such as jewelry, bookends, flower-pots, handbags (45:108).

The classes of work that must continue during wartime, as identified by Mr. Nelson, show some of the complexities to go with managing a wartime economy. A balance must be struck between the production of war materials and the production of civilian goods. The whole economy must continue to function.

At the beginning of the program to rearm the U.S. in 1940 the balance between civilian production and military production was missing and, as a result, shortages began to develop almost immediately in such items as cotton, flannel and linen cloth; cotton duck and webbing; aluminum, and various alloy steels (33:457). While some of the cause for the shortages may be attributed to the expansion of the industrial base, much of the problem was due to inadequate management of the production effort during the early stages of the rearmament process.

During the transition from a peacetime economy to one of wartime it can be expected that conflicts of interest will arise between military requirements, public demands for consumer goods, and the desires of private business to continue to make profits. Effective control must be established by the government to maintain the delicate balance between the needs of the citizens, the needs of the military, and the needs of business. The U.S. did not have that needed controlling function in place as we began to rearm. One source had the following to say:

The logical construction of the philosophy and technique of wartime control was not recognized in the earlier phases of production for the second World War, although it was clearly delineated in the experience of the first. The failure to recognize this situation was in part the result of an under-estimate of the magnitude of the war requirements. In part, it was the result of an unwillingness to introduce more extensive controls than the exigencies of the moment dictated. But in more general terms, it resulted from the absence of an established industrial-mobilization organization which had a long-range view of both the problems of controlling wartime production and the problems of dealing with them (46:18).

The NDAC was the government's first group organized for the purpose of "studying, consulting, and acting on defense production" (45:87). However, as one of its members stated "the NDAC was not a war production board, nor was it an office to 'manage production'. It was an 'advisory commission'. . . (45:87). While it may be that the NDAC was not established as a war production board, the type of tasks it was assigned certainly fell under that heading. Tasks assigned included establishing priorities to control the use of war materials, and promoting the expansion of facilities to meet production

requirements. The NDAC was given the responsibility to control the production effort, however it was not given the authority to accomplish the task, as can be seen from the following example.

In the early months of 1940 the Army began increasing its orders for aircraft with manufacturers such as Douglas and Lockheed. During the same time span private industry, recognizing the demand for increased air travel, had placed orders for planes to meet their anticipated demands. The Army wanted the private industry orders cancelled even though the manufacturers assured the government they could fill both orders without difficulties. The NDAC sent production experts to the manufacturer's plant to evaluate the manufacturer's production capability. The NDAC evaluation agreed with the manufacturers' claim that they could fill the orders of both the military and private industry. However, the Army insisted the orders placed by the private company should be cancelled. The Under Secretary of War made the decision that "production of all commercial planes, and all engineering on commercial planes had to stop" (45:111). The NDAC, lacking authority, had to issue the order to the aircraft manufacturers to halt all work on commercial aircraft. As a result of the desires of the Army and the Under Secretary of War, production of commercial aircraft stopped.

It was the lack of authority that would cause the demise of the NDAC as it became obvious the control of the war production effort required authority to be effective. As a

result, President Roosevelt in late December 1940 announced his intentions to replace the NDAC with a stronger agency. On 7 January 1941 the Office of Production Management (OPM) was established, under the administrative direction of the Office of Emergency Management, for the purpose of controlling industrial production. The responsibilities of the OPM included:

1. Increasing and regulating the production and supply of defense materials, equipment, and emergency plant facilities.
2. Analyzing and summarizing the requirements of the Army and Navy and foreign governments for defense material.
3. Taking the lawful steps necessary to secure an adequate supply of materials for defense production.
4. Developing a priorities program (45:118).

The OPM was short lived as it too suffered many of the same ills that had plagued the NDAC, the biggest of which was lack of real authority. The power the OPM had did not have legal precedence and, as a result, the agency was ineffective when it tried to enforce its two main instruments of control, the issuance of preference orders and priority ratings. The issuance of preference orders "was supposed to encourage firms to push military work ahead of civil production", while priority ratings "gave military contractors first priority on scarce resources" (2:135). However, without enforcement authority its policies soon broke down as "the military demand for scarce raw materials and production facilities outran the supply" (2:135).

The OPM, although it lacked authority, did manage to get industrial production underway for support of the war effort. However, the signs were obvious that something had to be done

to bolster control of the production effort. Some of the problems plaguing the progress of war production in 1941 were shortages of aluminum (although we had increased production from 400,000,000 pounds in 1940 to 600,000,000 in 1941 it still was not enough to support planned aircraft production) magnesium, copper, nickel, and machine tools.

While the years of Allied support had established a wartime industrial base on which the U.S. could build, it is clear that at the time of Pearl Harbor we were far from being the "arsenal of democracy" we would later become. After Pearl Harbor the emphasis of the United States war production changed from being a "defense program" to being a "victory program". On 6 January 1942 President Roosevelt in an address to the Congress, outlined the production goals for the victory program. They were:

1. To increase airplane production rates in 1942 to 60,000 and to 125,000 in 1943.
2. To increase tank production rates to 45,000 in 1942 and to 75,000 in 1943.
3. To increase production rates of anti-aircraft guns to 20,000 in 1942 and to 35,000 in 1943.
4. To increase production rates of merchant ships to 8,000,000 deadweight tons in 1942 compared to 1,100,000 deadweight tons in 1941 (45:187).

To provide the needed guidance for the monumental task, the War Production Board (WPB) was established on 16 January 1942 for the purpose of directing the Nation's industrial mobilization effort. The WPB superseded the OPM and had as its charter:

1. General direction of the war procurement and production program.

2. Determination of the policies, plans, and procedures of the several Federal departments and agencies having influence upon war procurement and production.
3. Administration of priority grants and the allocation of vital materials and production facilities (13:40).

The WPB differed from its predecessor, the OPM, in that it was headed by a single chairman who had sole responsibility for the decisions made while the other members of the Board served strictly as advisors. Another important difference was that the chairman was given the authority to carry out the responsibilities of the WPB.

The automobile industry was the heart of American industry when we entered the war. It was directly responsible for the employment of 500,000 people and indirectly responsible for the employment of 7,000,000 more. In addition, it used large quantities of raw materials (See Table 16). One author wrote the following about the automobile industry at the time of the war: "The industry has undoubtedly the greatest reservoir of technical and mechanical talent, and the greatest pool of inventive skills ever assembled" (45:212).

Table 16.
A Partial Listing of Raw Materials Used
by the Automobile Industry in 1942 (45:216)

<u>Raw Material</u>	<u>Percentage of U.S. total</u>
Iron	51%
Plate glass	78%
Upholstery leather	68%
Rubber	80%
Steel	18%
Aluminum	10%
Copper	13%
Lead	34%

After Japan attacked Pearl Harbor the automobile industry was asked to produce:

1. 75 percent of all aircraft engines.
2. More than one-third of our machine guns.
3. 80 percent of the tank and tank parts.
4. 50 percent of the diesel engines.
5. 100 percent of motorized units for the Army (45:217).

World War II marked the introduction of mechanization to warfare on a large scale. The famed German strategist, General von Metzsch, wrote:

The cardinal principle of modern warfare will be the utmost mobility on land and in the air. Such warfare will aim at sudden concentrations of enormous strength at a point where a decision is sought (45:43).

Perhaps the greatest production success of the war was that of the U.S. aircraft industry. In 1939 the production of the entire aircraft industry was 5,865 planes. By 1942 handcraft industry had adopted some of the automobile industry's techniques and, as a result, begun mass production of aircraft. In 1944 the industry reached peak production of 96,318 aircraft as research and development agencies reached new heights designing combat aircraft (24:481) (28:59).

The U.S. industrial might was harnessed (See Table 17) and became the "arsenal of democracy" President Roosevelt had called for. The production levels reached during World War II were indeed staggering, but, as we have seen, they were not achieved overnight and many problems were encountered along the way.

One problem that haunted U.S. production efforts throughout the war was material and manpower shortages. It

took hard work, ingenuity, and a little luck to overcome them. Major shortages which affected production included raw materials, labor, and machine tools. The lack of sufficient raw materials such as rubber, copper, and aluminum, was experienced early in the war. A variety of efforts were employed to work around the shortages encountered.

Table 17.
Industrial Production for the Armed Forces
During World War II (29:8)

Major Weapons Systems

10 battleships
27 aircraft carriers
88,000 tanks
110 escort carriers
45 cruisers
358 destroyers
504 destroyer escorts
211 submarines
310,000 aircraft

Weapons

41,000 guns and howitzers
750,000 rocket launchers and mortars
2,680,000 machine guns
12,500,000 rifles and carbines

Ammunition

29,000,000 heavy artillery shells
100,000 16 inch naval shells
845,000,000 rounds of light gun and howitzer shells
105,000,000 rocket and mortar shells
40,000,000,000 rounds of small arms ammunition

Transportation Equipment

46,706 motorized weapons carriers
806,073 2.5 ton trucks
82,000 landing craft
7,500 railway locomotives
2,800 transportable road and highway bridges

The following example will serve to show the kinds of steps that were taken to overcome shortages of raw materials. It was recognized as early as 1940, when the NDAC urged the government to build four experimental synthetic-rubber plants, that rubber was a vital commodity to virtually every aspect of the American economy and indispensable for the mobilization of the military. Donald M. Nelson, Chairman of the WPB, wrote the following:

Most of the wars in the past could have ben fought with little or no rubber, but the kind of war which was overwhelming the world in 1942 needed this commodity at almost every turn. It was needed for tanks and for planes and for every other kind of moving vehicle. Since we had mechanized our artillery as far as possible, we needed pneumatic tires for that and for scores of thousands of trucks. We needed it in uncounted places in our ships. Rubber was just about as essential to the mobility of modern war as was petroleum (45:290).

In June 1940 the Congress, acting on the recommendation of the NDAC, amended the Reconstruction Finance Act of 1933 to provide loans for the purchase of needed materials. It was under this legislation that a program to build a synthetic rubber industry was funded. At the beginning of 1942 the U.S. had enough rubber stockpiled to meet a "peacetime" demand of one year, but with the war the chances of receiving more surplus from the Far East were not good. The only synthetic U.S. rubber plant in operation at the time was a Goodrich plant with a capacity of 2,500 tons a year (45:292). It was evident the U.S. did not possess enough rubber to support a modern war. At this point the WPM began planning to overcome the shortfall. The basic plan involved three issues. First, non-essential consumption of rubber was eliminated and essential requirements

which did not directly support the war needs were curtailed. This was accomplished through an allotment program to govern the materials needed or produced by the rubber industry and through the rationing of tires and gasoline. In November 1942 gasoline was rationed at 3 gallons per week throughout the U.S.. This reduced the operation of private vehicles and conserved our precious supply of rubber. The second part of the plan called for the reclamation of scrap rubber which would be recycled and used again. The final part of the plan called for the expansion of our synthetic rubber capabilities. A production goal of 300,000 tons of synthetic rubber was set for 1943 with a follow-on goal doubling that amount for 1944.

The total amount of rubber required by the U.S. for a 21 month period running from 1 April 1942 through December 1944 was estimated to be 960,000 tons. Of that total, 734,000 tons represented the bare minimum the Army and Navy required and the remaining 236,000 tons represented the absolute minimum civilian requirements. A note of interest is that of the 236,000 tons required for civilian use none was allocated for passenger tires. The total amount of rubber available to support U.S. requirements during this 21 month period was projected to be 736,000 tons or a shortage of 224,000 tons.

The solution to the estimated shortage of rubber was to refine the original plan by further reduction of non-essential use of rubber, expanding the production goals for the synthetic rubber industry, and increasing the reclamation program (45).

Labor, both skilled and unskilled, is a key ingredient to successful industrial mobilization. However, often labor's problems and contributions are overlooked while attention is focused on the end products of mobilization. An examination of U.S. labor during the war years is essential to the study of our industrial mobilization for World War II.

The number of unemployed people in the U.S. in 1940 was estimated to be from 5,000,000 (the number of people registered with the United Employment Services) to 11,000,000 (accounting for those not registered) who could be brought into the workforce (24:82). While there was a large labor pool available, there were shortages of various skills due to the long years of the depression. Trades such as machinists and welders were depleted of skills during the depression as workers took on any work they could find to live. To gear up U.S. industry for war production it became necessary to establish training programs to develop the required skills.

The Labor Department was tasked with developing the initial plans to implement a nation wide training program in over 150 colleges and in some 1,200 vocational schools throughout the U.S.. It was recognized here was no replacement for on-the-job experience and a Training-Within-Industry Branch was established within the Labor Department. The purpose of the Training Branch was to establish with industry a program in which workers could gain training and experience on the job. Over 2,000 contractors and subcontractors participated in the program and by February 1942 more than 3,300,000 workers had

participated. It was obvious as early as 1941 that shortages of labor were likely to occur as the U.S. began to expand its war production effort and its military forces. The aircraft industry is an example of what was occurring in a number of industries. Although employment in the aircraft industry had increased by an estimated 58 percent by January 1941 there was still a shortage of some 200,000 workers.

Union membership in the United States grew larger and more militant during the war years as it sought to exert its influence for higher wages and better working conditions. The government realized the unions were a force to be reckoned with and, as a result, in March 1941 the National Defense Mediation Board (NDMB) was established in hopes it could help resolve disputes between labor and management. The Board was made up of equal membership of labor, management, and government. While the Board attempted to avert the types of strikes which caused problems during World War I, it was ineffective in doing so largely because it lacked authority to impose settlements. The President, after Pearl Harbor, established the National War Labor Board (NWLB) to help avoid work stoppages in the defense industries. The NWLB developed wage controls and assisted in reaching settlements between labor and management.

Labor leadership, caught up in the wave of patriotism after Pearl Harbor, promised to support the war effort and vowed there would be no strikes. However, the promise soon faded and strikes occurred throughout the U.S. and throughout the war (See Table 18). The NWLB was kept busy and by the end

of the war had approved some 415,000 wage agreements involving 20,000,000 workers, and in addition had imposed nearly 20,000 settlements (2:145).

Table 18.
U.S. Wartime Strikes 1942-1945
(2:144)

<u>Year</u>	<u># Strikes</u>	<u># Workers (millions)</u>	<u># Man-days idle (millions)</u>
1942	2,968	0.8	4.2
1943	3,752	2.0	13.5
1944	4,956	2.1	8.7
1945	4,750	3.5	38.0

The number of strikes and the number of workers and man-days involved, makes the wartime achievement of the U.S. industrial base during that much more amazing.

As in World War I, women and minorities played a major role filling industry's intensive labor requirements. By July 1944 the number of women in the labor force had increased to 19,000,000 (a 47 percent increase over 1940). Most of the women were employed in manufacturing, such as aircraft and ship building, and steel and munitions production. The number of women employed in the manufacturing sector during the war increased by 110 percent.

While the expansion of the industrial base was incredible, a point to remember about the accomplishments of U.S. industry in World War II is that it took several years for most industries to reach peak productions. For example, it took the aircraft industry until 1944 to reach its wartime peak

production of 96,318 aircraft (See Table 19). It is not the intent of this researcher to diminish the war production effort by U.S. industry but to merely bring out the fact that it took time and will always take time to expand the industrial base for the purposes of our national military employment.

Table 19.
Aircraft Production and Requirements
(1940-1943) (24)

<u>Year</u>	<u># Required</u>	<u># Produced</u>
1940	50,000	12,804
1941	50,000	26,277
1942	60,000	47,836
1943	125,000	85,898

Production rates, while vital, are not the end all. The capacity to turn out supplies and equipment means little if they can not be distributed to the point of need when they are needed. The ability of the railroads to perform as required during the war was of great concern, especially given the problems encountered during World War I.

In December 1941 President Roosevelt established the Office of Defense Transportation (ODT) to accomplish the following:

. . . coordinate the transportation policies of all government agencies, investigate essential requirements, determine the capacity of all carriers, advise on allocation of scarce resources, and avoid traffic congestion like that of World War I. . . (2:148).

The carriers themselves established effective advisory committees and employed better management of the railroad cars. Approximately \$8 billion worth of improvements had been made

railroad facilities since World War I. These facts explain why government control of the railroads was not implemented during World War II as it had been during the previous war. The railroads during World War II, despite having fewer locomotives, railroad cars, and workers than in World War I, still managed to move three-quarters of the wartime freight and one-third of the passengers (2:146).

While the railroads remained the lifeline of U.S. war production in World War II, other parts of the transportation system emerged to play important roles as well (See Table 20).

Table 20.
Volume of U.S. Intercity Freight Traffic 1941-1945
(millions of ton-miles) (2:146)

<u>Year</u>	<u>Railroads</u>	<u>Highways</u>	<u>Waterways</u>	<u>Pipelines</u>	<u>Airlines</u>
1941	481,756	63,258	110,005	68,428	19
1942	645,422	48,626	130,916	75,087	34
1943	734,829	46,394	138,791	97,867	53
1944	746,912	47,395	136,963	132,864	71
1945	690,809	53,442	131,801	126,530	91

The decrease in highway miles, as shown in Table 20, can be attributed to gasoline rationing. Of additional interest is the increased use of pipelines and aircraft as modes of transport, suggesting what lie ahead for the transportation system of the United States.

Of significant importance were the oil pipelines. The ability to transport oil to where it was needed had been severely impaired by German U-boats sinking the transport ships. U.S. Naval historian, Samuel Eliot Morison wrote, "The massacre enjoyed by the U-boats along our Atlantic coast in

1942 was as much a national disaster as if saboteurs had destroyed half a dozen of our biggest war plants" (30:108). The massacre Mr. Morrison referred to was the loss of 391 merchant ships, of which 141 were tankers, to the German U-Boat campaign in 1942. Admiral Karl Donitz, Commandar of the German U-Boat Force realized the importance of oil in modern warfare and made the following comments in February 1942, "Can anyone tell me what good tanks and trucks and airplanes are if the enemy doesn't have fuel for them? Yet the High Command can't see it" (30:103).

Although the United States was at the time by far the largest producer of crude oil in the world (See Table 21) and there was enough oil production to meet the requirements, still there were spot shortages. The case in point, and one that Admiral Donitz understood well was "having oil" and "having oil where it is needed" is not the same thing. T. H. Vail Motter, U.S. Army historian summed up the value of oil this way: "No matter how well fed, equipped, or officered, without oil and gasoline the modern army is a hopeless monster, mired and marked for destruction" (30:160).

Table 21.
U.S. Crude Oil Production 1941-1945
(in millions of barrels per day) (30:166)

Year	U.S. Production	Rest of World	U.S. as Percent of World
1941	3.8	2.3	63.1
1942	3.8	2.1	66.3
1943	4.1	2.1	66.7
1944	4.6	2.5	64.7
1945	4.7	2.4	66.0

The German U-Boat campaign was successful in disrupting both Allied and U.S. oil supplies. Due to the German U-Boat attacks total oil shipments from the Gulf of Mexico to the eastern seaboard dropped by 321,000 barrels per day in 1942 compared the rates in 1941. The United States began rationing gasoline more to conserve rubber than oil but the supply of oil available to the east coast had been significantly impaired. U.S. home owners living in the East and Midwest were persuaded by the government to find other alternatives, such as coal, to furnish heat for their homes.

In the United States the disruption in the oil supply was minor when compared to that of Great Britain. Gasoline rationing had been a way of life in Great Britain since September 1939 but the reduced imports of oil received in 1942 forced them to make even further cut-backs. In July 1942 it was mandated in Great Britain that no fuel was permitted for discretionary private use. This included major reductions in Great Britain's public buses and motor coaches. As a result, intercity traffic was reduced to the absolute minimum and bicycles became a vital mode of transportation.

The contributions of the oil pipelines were great. One oil pipeline known as "Big Inch" was built to help with the oil pinch being felt by the U.S. citizens living on the east coast and to improve distribution to the Allies. Big Inch was certainly a fitting name for the pipeline whose diameter was twenty-four inches. It ran 1,400 miles from Longview, Texas, to Linden, New Jersey. The massive pipeline had a 300,000

barrel per day capacity and the oil in the pipeline traveled at a rate of five miles per hour. The 1,400 mile journey took two weeks from the time a "barrel" of oil was put in at Longview until it was received in Linden (30:118).

Big Inch was not the only pipeline built in 1942. A total of 6,800 miles of pipe was laid or existing pipe converted to pump oil in less than a year. The combination of oil pipelines and railroad tanker cars virtually halted the enemy's influence on the delivery of U.S. produced oil to industrial or export sites. On the other hand, Allied air attacks on German oil production facilities cost Germany the war in the opinion of Albert Speer, Germany's Minister of Armaments and Munitions during the war. Speer stated in a deposition before the International War Crimes Tribunal, held in Nurnberg after the war:

All of our attempts [to prosecute the war] were fruitless, however, since from 12 May 1944 on our fuel plants became targets for concentrated attacks from the air. This was catastrophic. Ninety percent of the fuel was lost to us from that time on. The success of these attacks meant the loss of the war as far as production was concerned; for our new tanks and jet planes were of no use without fuel (30:302).

The importance of oil was also evident in the Pacific as the Allied forces battled the Japanese. Japan is a country poor in raw materials and its production of crude oil during the war was less than 5,000 barrels per day. However, the Japanese began stockpiling oil in 1940 in preparation for war. Japan on 12 January 1940 terminated the Treaty of Judicial Settlement, Arbitration and Conciliation with the Dutch who controlled an oil rich colony in the East Indies. Termination

of the treaty meant Japan was no longer legally bound to peacefully negotiate disputes with the Dutch colony. Shortly after termination of the treaty Germany invaded the Netherlands, which meant there would not be very much help available for a small colony far away from home. The Japanese took advantage of the situation and began demanding oil from the East Indies and eventually gained control of the Dutch colony. In addition to the oil it received from the East Indies, Japan began importing large shipments of crude oil. In six months time the Japanese purchased some 2.3 million barrels of oil from the U.S., and by the beginning of 1941 the Japanese had stockpiled an estimated 70 million barrels of oil. By September 1941 the Japanese oil stockpile had been reduced to 50 million barrels, less than a two year supply, with little hope of new supplies. After assessing the alternatives Admiral Nagano informed the Emperor of Japan on 6 September 1941 that:

The government has decided that if there were no war, the fate of the nation was sealed. Even if there is war, the country may be ruined. Nevertheless, a nation which does not fight in this plight has lost its spirit and is already a doomed nation (30:102).

An illustration of the role oil played in the Pacific theater in 1945 was the comments made by Lieutenant Commander Ono, Japanese staff officer of the Thirteenth Naval Air Flotilla, "Shortages of fuel prevented planes from averaging more than two hours flying time a month. It worked out that a plane was only used on the average of once every three weeks" (30:318).

The eventual demise of the Japanese war machine was accomplished by the Allies closing-off Japan's shipping lanes, which cut-off any hope of Japan getting oil to continue the war. Dependence on foreign sources for a raw material, oil in this case, resulted in the Japanese being unable to sustain its war fighting capabilities which ultimately led to its defeat.

The herculian World War II production effort of the U.S. resulted from strong national will and our ability to focus that will towards the common goal of winning the war. While the demands placed on U.S. industry to produce the tools of war were unbelievable, the industrial base responded with levels of production that have never been equaled. Industries which were virtually non-existent before the war, such as the synthetic oil industry and the aircraft industry, were built from the ground up as American industry rose to meet the challenges of war.

The United States truly became the arsenal of democracy in World War II as our munitions industry produced 40 percent of the world's output of munitions in 1943 and 1944. From the beginning of the U.S. rearmament program in 1940 to the end of the war in 1945 the munitions industry produced \$183.1 billion worth of munitions.

U.S. industry clearly demonstrated during World War II that provided with two things, enough time and enough capital, it was capable of expanding to produce the war materials needed to support modern war. Fortunately, there was enough of both.

Lessons Learned - World War II

1. The trial and error approach to mobilization was once again employed and once again found ineffective.
2. Government and industry must be partners if a large-scale industrial mobilization is to be successful.
3. Without public support, any industrial mobilization is doomed. Political leadership must provide the people needed information so they are prepared to support the mobilization effort when called upon.
4. The more prepared we are before hand with plans, stockpiles, government funding, etc., the greater the chance of reducing the time required for mobilization. The benefits of prior preparation include saving lives and money through planned use of resources to quickly attain military readiness.
5. The importance of raw materials to modern warfare and the need for adequate stockpiles was clearly demonstrated time and time again.
6. Machine tools are the backbone of production in time of war. Steps need to be taken to ensure there are reserve stocks of them available in times of industrial mobilization.
7. Trained people are something we must have to mobilize the industrial base. Training programs need to be on-going to reduce the time it takes to mobilize.
8. Shortages are a fact of war and our planning needs to address ways to work around possible shortfalls.

WW I and WW II in Comparison

The United States involvement in World War II resembled in many respects our World War I experience. Supplying the Allies with war materials was our initial contact with the war. As was the case in World War I, there was no "master plan" for the mobilization of the Nation. The lack of an established mobilization policy resulted in our once again using a trial and error approach to mobilization. As a result, many of the mistakes of World War I became the mistakes of World War II.

While there were many repeated mistakes, our failure to establish a central controlling function for industrial mobilization was the most costly. A central agency to control mobilization eliminates some of the confusion that is sure to surround industrial mobilization. Having one agency in control of mobilization simplifies the lines of command and communication and simplification is essential in times of emergency.

World War I lasted eighteen months for the U.S., yet it took nearly a year to develop an effective agency, the WIB, to control industrial mobilization. U.S. leadership failed to make use of the knowledge gained from World War I and, as a result, years passed before the WPB evolved to serve as the central controlling agency for industrial mobilization.

Another mistake repeated in World War II by the U.S. was once again forgetting that manpower is more quickly mobilized than industry. Consequently, there was an initial shortage of supplies and equipment required for the proper training of our

troops. Industrial mobilization is time intensive and, as such, requires extensive planning for its effective use.

Perhaps the hardest thing to understand about the U.S. industrial mobilization experience in World War II was the reluctance of planners to capitalize on the knowledge of people such as Bernard Baruch, Chairman of the WIB during World War I. Donald M. Nelson, at the time a member of the NDAC, made the following comments about a meeting that took place with Mr. Baruch in early 1940:

Mr. Baruch described his theories of organization clearly and concisely. He placed special emphasis upon the Industry Committees which had been vital to him in the last war. He thought that Industry Committees might be the answer to many of our most worrisome problems. I found out later that he was right, and it was, undoubtedly, too bad that we did not get around to the development of these until the War Production Board was rolling along. Perhaps the high point of Mr. Baruch's counsel concerned priorities, which he considered the "synchronizing force" of any war production program. This lesson, too, we were to learn, although not as soon, perhaps, as we should have (45:90).

It was a grave error on the part of the U.S. to neglect the invaluable experience gained by Mr. Baruch in World War I. As a result it took years to accomplish things he had recommended at the start of the war.

The United States did learn from some of our experiences in World War I and used the knowledge effectively in planning the mobilization of the economy during World War II. The organization and management of the railroads in World War II clearly benefited from the experience of the previous war. Efficient management of railroad assets, and cooperation between U.S. government and the railroad industry, avoided

government intervention as well as the railroad congestion of World War I.

The Roosevelt administration learned the economic lessons of World War I and worked hard to see that inflation, was prevalent throughout the U.S. during World War I, was held in check during World War II. The Office of Price Administration (OPA) was established in August 1941 to control inflation. To assist the OPA the Congress passed the Emergency Price Control Act in January 1942. The Act gave the OPA authority to control prices. Through controlled prices the rationing program the OPA established successfully controlled inflation during World War II. The difference in the standard of living of Americans during the wars serves as evidence of the effectiveness of the CPA during World War II. During World War I the standard of living dropped for U.S. citizens due to inflation but the standard of living rose for Americans during World War II even though the military portion of the Gross National Product (GNP) went from 10 percent in 1941 to over 40 percent in 1944.

The U.S. experiences of World War I and World War II, while having similarities, had some very distinct differences as well. First and foremost was the difference in the scope of the wars. World War I lasted eighteen-months for the U.S. while World War II lasted nearly four years. Over 7.5 million U.S. troops served over seas during World War II as opposed to 2 million troops in World War I. The difference in the scale of production between the two wars was staggering. For example, in World War I the U.S. munitions industry produced

3.5 billion rounds of small arms ammunition compared to 40 billion rounds of small arms ammunition in World War II. Another difference that stands out is the role mechanization played. While mechanization was introduced in World War I with the advent of the gasoline engine, it simply dominated the battlefield in World War II. The number of tanks produced during both wars clearly shows the domination of mechanization in World War II. Up until 11 November 1918 the U.S. had produced 77 tanks compared to the 88,000 tanks produced by the U.S. during World War II. A final difference that sets the two wars apart was out of World War II came the most destructive weapon the world has ever known, the atomic bomb.

Post World War II

The war came to an abrupt end after the dropping of the atomic bomb on Hiroshima and Nagasaki. The Japanese accepted the terms of surrender on 14 August 1945 and signed the instrument of surrender aboard the USS Missouri on 2 September 1945.

The period between the conclusion of World War II and the U.S. involvement in the Korean War could be entitled "Five Years of Chaos". Demobilization fever swept the nation in late 1945 as people, tired of the war, clamored for the quick return of troops from overseas. At the end of World War II there were 12 million U.S. troops spread throughout the world. Plans for demobilization had begun in 1943 when it appeared victory was assured. The plan devised for discharging U.S. troops was

based on a point system which awarded points to each service member based on the length of service, service overseas, combat duty, and parenthood. The points were awarded as follows:

1. One point for each month in service.
2. One point for each month overseas.
3. Five points for each battle/campaign star
4. Five points for each combat decoration.
5. Twelve points for each child (three child limit)
(47:144).

The calculation of points, known as the Adjusted Service Rating, was done twice. Once following V-E Day, 8 May 1945, and the second time following V-J Day, 2 September 1945. The Adjusted Service Rating based the points on a starting date of 16 September 1940, and upon completion of the point calculations service members with the highest point totals were discharged. The minimum allowable point total for discharge was initially set at 85 in June 1945, and then reduced to a low of 50 in December 1945.

Even though the time to process an individual for discharge had been reduced from an estimated 12 days after World War I to a minimum of 2 days after World War II, there was still pressure to get the "troops home". With the demobilization of U.S. military forces in high gear, the number of service members discharged between 1 September 1945 and 31 May 1946 was over 9 million.

The "point system" as the sole criteria for discharging people caused problems for the military because the process did not consider the on-going missions the military was required to support. As a result of the demobilization of the military as individuals, as opposed to units, unit integrity was not

maintained and this made the task of supporting day-to-day requirements very difficult. Another problem with the point system as a demobilization tool was it did not provide for the gradual loss of skilled technicians and, consequently, before long such actions as officers trying to perform the duties of enlisted mechanics became common.

An additional problem caused by the rapid demobilization of U.S. military forces at the end of World War II was what should be done with the estimated \$50 billion of equipment and supplies located throughout the world. The following illustration presents just a fraction of the enormous task the U.S. faced:

As of August 1945 total stocks in the Mediterranean Theater of Operation (MTO) amounted to an estimated five million tons, while those in the European theater came to another twenty-four million tons. About one million tons a month could be shipped from European ports. By the spring of 1946 the European Theater of Operation (ETO) forces were down to occupation strength, but they were concentrated in Germany far from the major ports where outshipments could be handled (33:582).

The abrupt end to the war found U.S. inventories of equipment and supplies at peak levels. The American forces in Europe at the end of the war had more supplies leftover than the total supplies used by the American Expeditionary Force (AEF) in 1917-1918. The Army had over \$31 billion worth of personal property located worldwide awaiting disposition at the end of the war, including 2,871 installations.

After demobilization of the U.S. military forces, the focus of the Nation turned to the revitalization of the civilian sector. As a result, there was a virtual collapse of

the "Arsenal of Democracy" immediately following the end of the war. The revitalization of the economy was accomplished in part by disassembling the industrial might the country had created in order to win the war.

The problems of excess supplies and equipment that plagued the military was also a problem for the government and industry. Many of the government's production plants were allowed to deteriorate because of insufficient funds allocated for facility up-keep. It has been estimated that the U.S. could have saved between \$200 and \$300 million, the cost to rehabilitate the facilities so they could be used during the Korean War, by investing \$50 million, the cost to keep the plants operational during the years between the conclusion of World War II and the beginning of our combat involvement in Korea (68:8).

The munitions industry illustrates what happened to several key industries during the post-war period. Heavy production of munitions came to a sudden halt at the conclusion of World War II. Because we believed we possessed a large surplus of munitions, estimated at 8 million tons, the government eventually dismantled the munitions industry. In the five years between World War II and the Korean War the government closed many munitions plants leaving only 38 of the 84 wartime munitions plants operable. The estimated lead time needed to start production was 13 months due largely to the poor condition of the facilities. Then, when we became involved in combat in the Korean War, the large surplus of

munitions disappeared yet we had to live with the long lead time for replenishment production.

The machine tool industry suffered a similar fate. The shortage of machine tools the U.S. had experienced early in World War II was now magnified because government owned machine tools were sold as war surplus for 15 cents on the dollar. This almost destroyed the industry. By 1951 U.S. machine tool capacity was only one-third of what it had been at the beginning of World War II (66:8).

Demobilization of U.S. military forces and U.S. industry after the war left the government with billions of dollars of surplus to dispose of. There were basically two forms of surplus, military supplies and equipment in the units and in storage facilities; and war production supplies, facilities, and equipment.

The disposal of surplus military supplies and equipment was the cause of much concern, just as it had been after World War I. Selling the surplus at nominal prices would tend to depress markets, while just letting the materials deteriorate would be wasteful. Another problem faced by officials was determining what should be saved and what should be disposed of. Other considerations included the trade-off between storage and maintenance costs of the surplus versus the possibility of the surplus becoming obsolete.

Agencies in charge of the disposition of surplus were tasked "to obtain for the Government, as nearly as possible, the fair value of surplus property" (33:564). The Congress

passed Surplus Property Act of 1944 to provide disposition agencies guidance in disposing of the surplus items. However, the Act was ineffective because it contained eighteen broad objectives which were not prioritized and, as a result, caused confusion among the disposition agencies.

Surplus was defined by the War Department as the property on hand which exceeded the sum of the following:

1. consumption during the demobilization periods;
2. the Peacetime Army Supply Program;
3. Western Hemisphere Defense Program;
4. approved supplies for the Phillippine Army;
5. the War Department Reserve; and
6. other requirements currently approved (33:565).

The guidelines provided by the War Department as to what qualified as surplus provoked debates centered around how much surplus, if any, should be maintained for future needs. The decisions made concerning surplus had long- lasting implications for the U.S. involvement in Korea.

Surplus disposal of U.S. military equipment and supplies overseas, particularly in Europe, was accomplished primarily through bulk sales. France made the largest purchase of U.S. war items. The original property value of the items purchased by the French was in excess of \$1.13 billion. In a separate purchase the French bought all remaining ammunition left in France at the close of the war, plus an additional 50,000 long tons of U.S. surplus ammunition located in Germany. Other countries which made similar purchases of U.S. bulk military surplus include England, Belgium, Italy, and Germany.

While the majority of U.S. military surplus in Europe was disposed of through bulk sales to other nations, that was not

the case in the Pacific. Large quantities of U.S. military supplies and equipment had been stockpiled throughout the Pacific in anticipation of the invasion of Japan. The stockpiles were so widespread that after the war it was thought impractical to attempt to return all the equipment and supplies to the United States. As a result large quantities of ammunition along with thousands of tanks, trucks, and artillery pieces were left behind to decay in the humid jungles of the Pacific. The equipment and supplies that were not as difficult to reach were either sold in bulk to other countries or returned to the U.S.

The U.S. wartime industrial base was still producing near peak levels when the war ended. Production by the war industries after the conclusion of hostilities served only to increase surplus. To avoid adding to the vast quantity of U.S. war surplus it became necessary for the government to terminate war contracts as quickly as possible.

Planning for the termination of war contracts had taken place long before the end of the war in an attempt to avoid the confusion of contract settlements following World War I. Consequently, by V-J Day the War Department had cancelled 59,000 of the ultimately terminated 135,000 contracts.

The nature of the problems encountered during the termination of war contracts fell into one or more of the following three areas. They were:

1. problems connected with the decision to terminate the contract;

2. problems dealing with the settlement of terminated contracts;
3. problems involving the disposition of war material (54:813).

Of particular interest to this research is the third category involving the disposition of war material. Understanding how the surplus of World War II was handled will provide insight into the preparedness of the U.S. to engage in the Korean War.

The number one priority of war contract terminations was expediency. An illustration of this is the order given by Under Secretary Patterson to contracting officers on 30 June 1943, stating in part:

Frequently this material must be sold at a substantial amount below its cost. in many instances, work in progress must and should be sold for scrap prices. It is inevitable that losses will take place. Rarely will delay in disposing of such property help the war effort or result in any substantial savings to the Government. Under present circumstances no materials should be hoarded merely in the vague hope that at some date the property may have a future use or a greater value. . . (54:887).

Statistics verify that the objective of the program was clearly met. By the end of 1945 some 80 percent of the war contracts had been settled and one year after the end of the war virtually all war contracts had been settled. The dollar amount of the terminated war contracts exceeded \$46 billion, more than ten times the value of the terminated World War I war contracts.

Demobilization of the Nation took place with the same vigor which the mobilization had effort realized. Although the objective of rapid demobilization was met, the implications of some of the decisions would haunt the U.S. during the preparations for the Korean War.

There were those individuals who expressed concern as to the manner in which the Nation would demobilize after the war. The President of Fairchild Aviation, Mr. Charleton Ward, addressed the Army Industrial College on 15 May 1944 and offered the following:

As soon as the war appears to be over there will be such a hue and outcry about the billions of dollars of our national debt that every political effort will tend toward economy in government, toward demobilizing our war machine, without any thought that it will have to be mobilized again (67:4-7).

Mr. Charles E. Wilson, President of General Motors Corporation, maintained the importance of preparedness during his 1944 annual report to the stockholders, where he stated in part:

. . . If we are to win the peace, we must continue to move forward by maintaining for preparedness equally close liaison between the armed services and industry. . . so that American industry shall ever be ready to set in motion quickly, if needed (69:6).

The concerns of people such as Mr. Ward and Mr. Wilson went by largely unnoticed as the Nation rushed toward demobilization with a fervor. The strength of the Army went from over 8 million troops in the summer of 1945 to less than 2 million in early 1946. By 1948, the Army was down to 680,000 thousand and the National Guard and the Reserves had been effectively dismantled. Demobilization was so rapid and severe that at the end of 1947 General J. Lawton Collins, Deputy Chief of Staff of the Army, testified before Congress that the Army could not mobilize a single division.

Despite the drastic demobilization that was taking place there were still those who were concerned about readiness of the U.S. and the debate over preparedness waged on during the

post-war years. The Vice Chairman of the War Production Board at the conclusion of the war urged:

. . . full peacetime preparedness according to a continuing plan. The burden is on all of us to integrate our respective activities political, military, and industrial because we are in world politics to stay whether we like it or not (49:21-2).

Representing the other side of the debate were individuals expressing more liberal views. Writers such as Harold Laswell, whose book The Garrison State was published in 1941, questioned the need for continued planning for mobilization. In 1947 Hanson Baldwin stated:

The military are getting the bit in their teeth. There is considerable evidence that their objective is absolute preparedness in time of peace, an objective which has led all nations which have sought it to the garrison state, bankruptcy, and ruin (4:481).

The country's strong desire to return to a peacetime status combined with the feeling there were adequate stockpiles of equipment and ammunition, plus the fact the U.S. had an atomic monopoly, contributed to mind-sets which have restricted learning what should have been gained from World War II.

Although there was little economic support in the military budget for preparedness during the post-war period, planning did continue. The Munitions Board was revived and a plan which joined industrial and civilian mobilization policies was drafted. An Industrial Mobilization Plan (IMP), developed by the Board in 1947 resembled in many respects the ones created following World War I. While the IMPs developed in the 1930s were never implemented in their entirety, they did provide some important guidance during World War II.

The new IMP described three distinct phases of industrial production. Phase I extended from peacetime operation to the point in time that the President determined the need for national mobilization. This part of the plan made it clear that a level of industrial readiness was to be maintained at all times. With the advent of mechanized warfare, and the long lead times required to produce such items, industry could no longer afford to wait until the declaration of war to begin mobilization. Phase II marked the point from when mobilization was declared by the President until Congress declared war. Plans, programs, and procedures developed in Phase I were put into play. Phase III began when war was declared, lasted until the end of the war. A General Director of National Mobilization would serve as the focal point for executive control over the mobilization effort (66:10).

In addition to the development of the IMP, there were several pieces of legislation passed which attempted to capitalize on the Nation's World War II experiences. They were:

1. Strategic and Critical Materials Stockpiling Act of 1946

The purpose of this Act was to provide for the acquisition and retention of stocks of materials and to encourage the conservation and deployment of sources of these materials within the United States, and thereby decrease and prevent wherever possible foreign dependence (25:7-8).

2. National Security Act of 1947

This piece of legislation created the National Military Establishment (NME) with three military departments, that included the creation of the U.S. Air Force, and a Secretary of Defense. The National Security Resources Board (NSRB) was formed to advise the President on matters concerning the coordination of mobilization (25:7-8).

3. National Industrial Reserve Act of 1948

This Act was to "provide adequate measures" whereby an essential nucleus of government owned industrial plants and a national reserve of machine tools and industrial manufacturing equipment may be assessed for immediate use to supply the needs of the armed forces in times of national emergency or in anticipation thereof (25:7-8).

The importance of having an adequate stockpile of essential materials needed to sustain U.S. war fighting capabilities was realized after World War II, just as it had been after World War I. The Congress passed the Strategic and Critical Materials Stockpiling Act of 1946 in an attempt to ensure the U.S. would not be dependent upon foreign sources for critical materials in times of war. The Act directed the Munitions Board to periodically review the contents of the stockpile and to update and delete its contents as needed. Additionally the Act authorized the Munitions Board to:

1. make the purchase of such materials "so far as practical from supplies of materials in excess of the current industrial demand,"
2. provide for their storage, maintenance and security, their rotation, and replacement to prevent deterioration, and
3. dispose of any materials no longer needed (13:74).

The Act was passed to try to correct a serious shortfall in U.S. mobilization capabilities. Although the Act was replaced by the National Defense Stockpile policy in 1982, it still provides the foundation for stockpiling critical materials.

The National Security Act of 1947 established the National Security Resources Board (NSRB). The NSRB was to advise the President on matters concerning mobilization of the U.S.

economy. The NSRB had not been operating very long when the Korea War broke out. Functioning as a planning and advisory agency the Board lacked authority to carry out the active mobilization of national resources. As a result, President Truman established the Office of Defense Mobilization in late 1950 to direct U.S. mobilization. Over the years the responsibilities of the NSRB have been assumed by other federal agencies.

The Industrial Reserve Act of 1948 identified the importance of the U.S. machine tool industry to mobilization. The Act provided the legal framework for government programs encouraging expansion of the machine tool industry during the Korean War. Government machine tool programs included the following:

1. Toolbuilder's Facilities Expansion Program: Under this program the government purchased and leased 2,375 tools, valued at \$31.3 million, to toolbuilders to enlarge their capacity to build other tools.
2. "Elephant Tool" Program: The government under this program, financed the production of large size, long lead-time tools required in the production of other large-size, general-purpose machine tools. The tools cost about \$5 million and, as of 30 June 1958, the government had realized \$2.2 million in rental fees.
3. M-Day Pool Order Program: This program (still in existence) was designed to furnish toolbuilders with mobilization requirements for general-purpose tools that would be "triggered" automatically in the event of an emergency. Called the "trigger" program, the contracts guaranteed purchase by the government if toolbuilders could not sell the tools manufactured under the program.
4. Korean Pool Order Program: Under this program, the government ordered 87,000 general purpose tools valued at approximately \$1.2 billion and guaranteed that the government would purchase under a specified formula if private buyers were not forthcoming. As of 30 June 1958, all but 400 tools of the original order had been sold to industry (13:161-2).

The government sponsored programs to stimulate the machine tool industry were successful in helping rebuild the machine-tool base that was allowed to deteriorate after World War II. However, the rebuilding of the machine tool industry did not occur overnight. The U.S. machine tool industry by 1951 had fallen to one-third of 1941 levels with thirty-four companies closing from lack of business (58:9).

An additional piece of legislation passed during the post-war years that concerned U.S. industrial mobilization was the Armed Forces Procurement Act of 1947. The Act gave the military departments a vehicle for protecting and building-up the U.S. industrial base by excepting contracts from competitive bidding when it became necessary to retain facilities and suppliers in the interest of national defense.

Korean War

Between the end of World War II and the start of the Korean War the Soviet Union came to prominence as a world superpower. While the United States was racing towards demobilization at the conclusion of World War II, the Soviets were embracing the the idea of military expansion. The U.S. closed the doors on defense production and transitioned to the output of consumer goods. However, the factories of the Soviet Union continued production of war materials. The production rates for tanks and planes exceeded those of their war effort. The announcement made by the Soviet Union declaring nuclear capability, plus its domination of Eastern Europe, caused

serious concern in the U.S. and gave us the reason to reevaluate how we would handle Soviet expansionism.

The United Nations asked the United States and the Soviet Union to accept the surrender of Japanese forces in Korea at the end of World War II. Korea was divided at the 38th parallel with the Soviets responsible for surrender actions north of the parallel, and the U.S. for surrender actions south of the parallel. It was never the intent of the United Nations to divide Korea into two countries, but the Soviets were able to exert enough influence to see a communist government established in the north. In the south the Republic of Korea was established as the formal government.

The Soviets were developing a strong native military force in North Korea furnishing both military training and equipment. North Korean military forces grew from an estimated 20,000 troops in 1946 to 135,000 by 1950. The intentions of North Korea to overthrow the South Korean Government became obvious long before the U.S. combat involvement in Korea. North Korea employed methods ranging from propaganda to acts of violence trying to influence the population of South Korea, and were somewhat successful in their efforts as noted by the report of General Wedyemeyer to President Truman on the Korean situation in 1947. The report concluded that "Current political and economic unrest in Southern Korea is aggravated by Communistic terrorism and by Communist-inspired riots and revolutionary activities in the occupied areas" (52:36).

The Soviets continued the build up of North Korean forces supplying such equipment as heavy artillery, armored vehicles, automatic weapons, and aircraft. While the North Korean Army was gaining strength, the U.S. was assisting South Korea with establishing a constabulary force. A force of 50,000 men was proposed. However, South Korea felt the constabulary force was an inadequate defense against North Korean forces. As a result, in November 1948, the Republic of Korea (ROK) passed the Armed Forces Organization Act. The U.S. had been supplying the constabulary force of 50,000 with weapons and equipment but by 1 March 1949 the ROK forces totalled 114,000 including an Army of 65,000 men, a police force of 45,000 men, and a coast guard of 4,000 men (52). The United States agreed to equip a ROK Army of 85,000 men. General MacArthur believed the ROK forces should provide for internal security and should be organized to clearly indicate a peaceful purpose. Consequently, South Korea was no match for the ever growing military strength of North Korea.

The United States, believing the job in South Korea complete, began withdrawing American troops from Korea in 1949. On 3 May 1949 the Soviet supported North Koreans made their first open raid across the 38th parallel. During the next year the North Koreans would stage hundreds of such raids into South Korea. While the ROK forces were successful in repelling the small-scale attacks of North Korea, the intentions of North Korea were to overthrow the Republic of Korea.

On 25 June 1950 North Korean forces invaded the Republic of Korea thus ending for the U.S. the peace of the post World War II era. The United States had no plans to counter the invasion of the Republic of Korea by North Korea. President Truman requested a meeting of the United Nations Security Council and on 25 June 1950 the Security Council adopted the U.S. proposal that the 38th parallel be reestablished as the boundary between the Republic of South Korea and North Korea and that the military forces of North Korea immediately withdraw from South Korea. The proposal also called upon "all members to render every assistance to the United Nations in the execution of this resolution and to refrain from giving assistance to the North Korean authorities" (52:87).

The United States began on 26 June to evacuate the 1,527 American civilians living in South Korea. On 27 June 1950 the ROK Government petitioned the United Nations for assistance. The Security Council responded by condemning the North Korean attack and recommending that members of the United Nations "... furnish such assistance to the Republic of Korea as may be necessary to repel the armed attack and to restore international peace and security in the area" (52:74). The crossing of the 38th parallel by North Korean forces was perceived by the U.S. and the United Nations as further indication of the Soviet Union's goal of world domination. Consequently, supporting a free South Korea became a priority action for both the U.S. and the United Nations. This included

the use of military forces to support the defensive actions of the Republic of Korea.

The large scale demobilization after World War II left the U.S. industrial base unprepared to support a large military force. As a result, the U.S. had to rely heavily on World War II surplus during the early stages of the war. Major General Elbert L. Ford, Chief of Ordnance, testified to the Congress in 1953 on the conditions of the munitions industry at the beginning of the Korean War. He stated:

In 1950, there was no ammunition industry for the production of metal components. Our reserve plants for the production of powder and explosives, and for the loading and assembly of finished ammunition were far from being in a state of immediate readiness for production (84:840).

The Chinese decision to join forces with the North Koreans served as the catalyst for the U.S. rearmament program.

Communist China was of concern to the U.N. in Korea from the war's beginning. China possessed a large and powerful army. Its involvement in Korea could pose serious problems for the U.N.. There was little evidence the Chinese were even contemplating getting involved in Korea until after the U.N. forces landed at Inchon. On 30 September 1950 Chinese Foreign Minister Chou En-lai warned, "The Chinese people absolutely will not tolerate foreign aggression, nor will they supinely tolerate seeing their neighbors being savagely invaded by imperialists" (52:187). Although there was no hard evidence that China intended to enter the fighting in Korea after the U.N. forces landed at Inchon, it was estimated that some 450,000 Chinese troops were gathered in Manchuria.

On 3 October 1950 Chou En-lai made it known that if United Nation troops entered North Korea, China would commit its troops which were waiting in Manchuria. Chou En-lai also conveyed the idea China would not interfere if ROK forces crossed the 38th parallel into North Korea. The Chinese threat did not receive serious consideration by the U.N. command because it was generally believed that if the Chinese intended to become involved they would not tip their hand in this manner. The United Nations' directive to restore security and peace in the area provided the legal basis for U.N. forces to enter North Korea. However, President Truman's top advisors were against the invasion of North Korea because they believed the situation would soon stabilize and that the U.N. could establish terms for the surrender of North Korea. General MacArthur and the Joint Chiefs of Staff did not agree with the President's advisors on the invasion of North Korea. MacArthur believed total defeat of the North Korean forces required crossing the 38th parallel into North Korea.

On 1 October 1950 General MacArthur sent a message to the North Korean forces demanding their surrender. He received no reply. MacArthur received authority to cross the 38th parallel into North Korea and on 7 October patrols from the U.S. 1st Cavalry Division entered North Korea. On 9 October the remaining elements of the 1st Cavalry Division as well as the British 27th Brigade, the ROK 1st Division, and the U.S. 24th Division crossed into North Korea across the boundary north of Kaesong.

Although the Communist Chinese began sending troops into North Korea on 14 October 1950, it was not until 25 October that hard evidence turned up confirming the Chinese involvement. The ROK 1st Division was involved in a skirmish in Western Korea and captured the first Chinese soldiers of the Korean War. While it should have been evident the Chinese had indeed made good their threat to enter the war if U.N. forces crossed into North Korea, the evidence was largely ignored because it did not conform to the results of studies conducted by the Joint Chiefs of Staff concerning possible Chinese involvement.

It soon became clear the Chinese had entered the war. MacArthur was informed on 3 November that as many as 34,000 Chinese troops had crossed into North Korea and an estimated additional 415,000 troops were prepared to enter North Korea if ordered to do so. The commitment of the Communist Chinese to support the North Koreans changed the complexion of the Korean War for the U.N. forces.

Understanding U.S. industrial mobilization policies of the Korean War years requires comprehending NSC-68, a Report to the National Security Council, 14 April 1950. It was generally believed the Soviet Union had gained atomic capability in 1949 (68:13). As a result, President Truman ordered a study to provide background information and guidance concerning nuclear weapons policy. NSC-68 predicted further growth of the Soviet Union's nuclear capabilities. The report went so far as to imply that the Soviets would have the technology by 1954 to

launch a nuclear attack against the U.S. (13:55). The United States' economic superiority was off-set by the Soviet's military advantages.

The thought that the Soviet Union would soon acquire thermonuclear capability forced the United States to develop its own thermonuclear capability as quickly as possible. In addition, the U.S. felt it important to increase conventional strength as well so as not to become totally dependent on nuclear weapons. NSC-68 recommended the U.S. seek to contain any further attempts of expansion by the Soviet Union.

Essential to the policy of containment was (and is) the maintenance of a strong military posture. Without a superior aggregate military strength, in being, readily mobilizable, a policy of containment would be no more than a bluff (66:68).

It became a question of "How to undertake a military buildup while, at the same time, maintaining public support?" The answer was believed to be a dynamic expansion of the economy. It was thought that if the expansion of the economy was large enough it could support the war effort as well as the rising national standard of living. The research by the authors of NSC-68 gave support to that idea.

The Defense Production Act of 1950 was in response to the President's request for legislation to assist in rebuilding the defense industrial base while, at the same time, avoiding inflation. The Act granted the President the power, both military and economic, to promote peace while opposing aggression. The seven titles of the Act gave the President the authority:

1. To establish a priorities and allocation system.
2. To requisition personal property and condemn real property.
3. To expand productive capacity and the supply of metals, minerals, and other materials.
4. To establish wage and price control.
5. To establish procedures to settle labor disputes.
6. To improve consumer and real estate credit controls.
7. To encourage small business participation in the program (13:56).

The Defense Production Act of 1950 gave the President unprecedented authority for the mobilization of the United States. Many of the Act's provisions are still in effect today (See Table 22).

Table 22.
Provisions of The Defense Production Act
(still in effect) (58:9)

<u>Title</u>	<u>Provisions</u>
I. Priorities and Allocations	<ul style="list-style-type: none"> - Priority contract performance - Allocation of materials - Prevention of hoarding
III. Expansion of Productive Capacity and Supply	<ul style="list-style-type: none"> - Purchase agreements, loans and loan guarantees, and installation of equipment
VII. General Provisions	<ul style="list-style-type: none"> - Small business encouragement - Authority to create new agencies, issue regulations and gather information - Voluntary agreements

U.S. industrial mobilization for the Korean War was very different from that of World War II. While World War II was a total mobilization effort, the mobilization policy for the Korean War was one of "creeping mobilization". The idea behind

creeping mobilization was gradual industrial buildup without disruption of the economy (1:138). Dr. James A. Huston explained the concept of creeping mobilization in an article for *Military Review*:

This was an attempt to get away from what had been too frequently the American reaction of living from crisis to crisis with buildup and letdown. The policy of creeping mobilization represented an attempt to establish a plateau of preparedness which would furnish a more satisfactory continuity of strength with which to meet not only current threats but also those which would be certain to arise in the future (1:138).

The question of "guns or butter?" associated with the total mobilization effort of the U.S. during World War II was not applicable to the Korean War mobilization. The phrase "guns and butter" better describes the intent of the mobilization supporting our involvement in Korea. While the phrase may leave a bad impression, suggesting an unwillingness of the American people to sacrifice in order to support the war, it accurately reflects the plan for expansion of the economy to support both the war effort and the standard of living (28:184).

President Truman initially intended to control the mobilization effort through agencies already established instead of creating new agencies as in previous wars. The Chinese involvement in Korea added to an already tense situation and the President declared a national emergency on 18 December 1950. In his proclamation, President Truman stated: ". . . the increasing menace of the forces of Communist aggression requires that the national defense of the United States be strengthened as speedily as possible. . ." (66:18).

The escalation of events in Korea caused the President to call for the creation of the Office of Defense Mobilization (ODM). The purpose of the ODM was to oversee the mobilization activities of the Executive Branch. The responsibilities of the ODM included production, procurement, manpower stabilization, and transportation activities (13:57). There were specific mobilization goals spelled out by Charles E. Wilson, ODM Director, in quarterly reports to the President beginning with that of 1 April 1951:

1. To produce military equipment for our armed forces in Korea and at home, for aid to our allies, and for reserve stock of which would be available for the first year of full scale war, if in spite of all efforts to prevent it, one should break out.
2. To provide additional production lines beyond those needed to provide for current military production so that they will be available in case of full scale war, and to add to the stockpile of scarce and critical resources.
3. To develop our basic resources and to expand our industrial capacity so that in the long run we may continue as large a military program as may be necessary and at the same time so that we may have a powerful industrial base.
4. Consistent with the above objectives, to maintain a healthy and productive civilian economy (33:858).

The objectives for industrial mobilization clearly indicate that the buildup for the war in Korea was only the foundation for a much larger goal: preparation for possible war with the Soviets.

The ODM quarterly report of 1 April 1952 puts forth the concept of building a mobilization base. The idea was to provide the United States an industrial base which could quickly transition from a peacetime environment to one of full mobilization in the event of war (27:144-5) (66:30). The

concept of the mobilization base was further defined by Defense Mobilization Order No. 23, issued on 23 November 1952:

The mobilization base is that capacity available to permit rapid expansion of production, sufficient to meet military, war-supporting, essential civilian, and export requirements in event of a full-scale war. It includes such elements as essential services, food, raw materials, facilities, production equipment, organization and manpower (27:144-5).

The reason for the mobilization base concept was the perception by the U.S. that the Soviets presented a threat to national security.

Expansion of the mobilization base was to be accomplished in stages, the first of which was supporting the effort in Korea. Support of the Korean War was supposed to provide the foundation for the next stage of expansion which was total mobilization. The initial target date for full mobilization capability was set as 1953 by the ODM in the quarterly report dated 1 April 1951 (81:2). The initial target date of 1953 was revised to 1954 in the ODM report dated 1 January 1952. The reason for the change in the initial target date of 1953, although not entirely clear in the report, appeared to be the amount of time needed to reach production goals of steel and aluminum (82:3-15).

The first year of the expansion was 1951 and the main accomplishment was getting prepared for full-scale production of war materials. Congress made available \$52 billion for military and related areas. Production goals included building 50,000 military aircraft and 35,000 tanks a year, in addition to producing 18,000 jet engines a month (81).

Production problems encountered that first year included the lack of adequate machine tools. The Korean War advanced modern warfare weaponry with the introduction of jet aircraft such as the U.S. produced F-84 Thunderstreak. Often the production of new weaponry requires new machine tools as well. "... There was also a tremendous need for new and larger types of machine tools. Some of these machines were in an early stage of development..." (55:214).

Another problem encountered during the early stages of the Korean war was the shortage in the U.S. of skilled people with experience in large scale defense production. Again, as had occurred in World War II, it was more a problem of production site location rather than having too few people with the needed skills. A prime example of this was the aircraft industry. The location of airframe manufacturers, as well as aircraft engine manufacturers, tended to concentrate on the coasts of the U.S.. Due to innovations in the aircraft industry production times had increased. "... The heavier, more complicated planes of 1951 required about four times the effort of those produced in World War II..." (55:208). The combination of increased production times along with the concentration of the production facilities caused a shortage of skilled labor in the U.S..

Long lead times due to technological advances were encountered during the Korean War. In World War II it was the aircraft airframe which required the longest lead time.

However, during the Korean War the longest lead time was required by the aircraft's electronic components (83:8-8).

The second year of the expansion, 1952, marked an accelerated buildup as Congress increased funding available for defense purposes to \$94 billion. By July 1952, aircraft production had reached production rates of 800 planes a month which was approximately two-thirds the expected rates for 1953 and 1954. In addition to increased aircraft production was the naval rearmament program which was well underway with more than 100 shipyards at work (13:80).

The program of expansion continued in 1953 and included production of military aircraft at a rate of approximately 1,000 per month. Emphasis on guided missiles was growing but they had not yet reached assembly line production rates. Artillery production gave Army and Marine units a 75 percent increase in fire power over their counter-parts of World War II. This increased fire power also applied stress to munitions production as the industry strove to meet rising demands.

Additionally, considerable progress was being made in the production of the first nuclear submarine. The expansion had progressed so well that by January 1953, there was a debate over the direction the production should take. The debate centered around whether to keep production lines active or let the programs run out and stop production altogether. The solution was a combination of the two considerations with some

programs being terminated and some programs being extended, such as tank and vehicle production.

In January 1953 the Advisory Committee on Production Equipment, which was assigned the task of evaluating issues concerning the machine tool industry, published its findings in a report to the Director of the ODM. The findings of the Committee not only applied to the machine tool industry, but were applicable to improving the concept of the "mobilization base" as well.

One recommendation of the Committee was that the Government should "substitute, to the greatest extent practicable, production capacity for the stockpiling of military end items" (66:31). The importance of this recommendation was it acknowledged the importance of maintaining production capability as well as maintaining stockpiles, both of which were necessary to have a mobilization base which could be expanded quickly in the event of an emergency.

The Advisory Committee on Production Equipment, also known as the Vance Committee, made a significant impact on U.S. mobilization policy with its report. Basic planning and programming policy put forth in the report became the foundation of U.S. mobilization planning until 1976. The report introduced a method for planning wartime stockage requirements known as the "D to P" concept. Under the D to P concept services were to stock enough war materials to support combat consumption from D-Day, the day military operations

begin, until P-Day, the point at which production of war materials equalled combat consumption of the war materials (13:138).

The Vance Committee identified several factors which affect the ability of the U.S. to mobilize its mobilization base. Time was listed as a crucial factor of U.S. industry and the report recommended the time it takes to reach wartime production rates be offset by war reserve stockpiles. Another factor listed was the high probability military equipment would become obsolete due to improvements in weapons design. The Committee noted that obsolescence would have a greater effect on the war reserve stockpile than it would the production facilities and consequently stressed the importance of maintaining a balance between production facilities and war reserve stockpiles. The final factor listed by the Committee was cost. The Committee concluded the producing of war materials on a large scale was more expensive than spending the capital required for establishing ample production capacity and maintenance of the production facilities. In other words, producing war reserve stockpiles was more expensive than creating and maintaining production capabilities of war materials.

The Vance Committee recommended several steps be accomplished to make the policy more effective. The steps included:

1. Realistic Mobilization Requirements: The Committee found that the statement of requirements for full mobilization went beyond the material, manpower, and productive capability of the nation. . .

2. New Production Capacity: Once the phased end-item requirements for mobilization have been established, the required capacity should be created. The ideal situation at the beginning of a mobilization period would be to have production facilities in being and ready to be activated quickly, plus enough reserves of end items to meet all needs until full production.
3. Keeping Capacity Up to Date: Any production capacity, once created, should be kept up to date so it can be activated quickly for an emergency. The Committee stated the Nation must not permit a recurrence of the mistakes made after World War I and II of letting its industrial machine deteriorate or be liquidated. The annual cost of maintaining production capacity in the form of standby plants or reserves of production equipment is a small fraction of the original cost and even smaller fraction of the cost of building up and maintaining war reserves. . . .
4. Support of Production Equipment Industry: A healthy production equipment industry is a key factor in the Nation's ability to maintain a healthy economy and an adequate mobilization base. Normal commercial business would not be adequate to maintain the machine tool industry at the levels attained after the Korean War. An annual Government expenditure of about \$300 million coupled with the expected commercial business of \$300 million per year would provide an adequate level of capacity to produce tools for defense in the future.
5. Government Facilities Needed: The Committee noted that certain types of large, heavy production, including basic heavy forgings and casting capacity, might not be created and maintained by private industry if they were commercially non-supportable. In those instances where private industry would not make the investment, the Committee proposed that the Government do so. Of particular concern was the so-called "elephant" category of heavy forgings and casting capacity, as well as heavy armor casting capacity for Army tanks. . . .
6. Modernizing All Industry: . . . an important objective of Government policy should be the maintenance of up-to-date, modernized industrial production facilities (66:34-35).

The recommendations of the Vance Committee in many respects remain valid today. The importance of modern facilities, Government facilities, and realistic mobilization requirements are as relevant to current U.S. mobilization planning as they were during the Korean War. Our implementation

of the recommendations of the Vance Committee over the years has been spotty at best. An illustration of our failure to learn from experience is the deterioration of U.S. wartime industrial capabilities following the Korean War, which occurred in the same manner as the deterioration of industrial capabilities that followed World War I and World War II.

The Korean War came to an end on 27 July 1953 with the signing of the armistice. At best it can be said the war ended in a draw. However, for many Americans the lack of a clear cut victory in Korea was difficult to accept and, as a result, there are those who feel we lost the war in Korea. But, we accomplished our goal which was to prevent the North Korean take-over of the Republic of Korea.

Lessons Learned-Korean War

Once again the United States was caught off-guard and unprepared to fight a war. The effects of massive demobilization of the Nation after World War II became painfully obvious as the U.S. struggled to support its combat involvement in Korea. Without the surplus war materials, left in the Pacific after World War II, to provide immediate support it is questionable how long the U.S. could have remained in Korea after the initial forced retreats.

The U.S. munitions industry failed to provide needed support, especially during the early stages of the war. Munitions production was reduced drastically after the conclusion of World War II. There was a general belief that surplus munitions from World War II were sufficient enough to

warrant the reduction of munitions production. However, expenditure of munitions in Korea was far greater than anticipated. The Korean War became a contest of Communist manpower versus U.S. fire power. Lt. Colonel John E. Harbert, 314th Ordnance Ammunition Group, had the following to say concerning munitions during the Korean War:

Communist forces in Korea have been employed against us on an 8-to-1 ratio. We have countered with a ratio of more than 100-to-1 in fire power. The pitting of fire power against manpower has led to unprecedented logistical problems. During a sixty-day period (19 August to 18 October 1951), 158,303 tons of ammunition were delivered to regiments and battalions of U.S. I, IX, and X Corps. . . . this represents 27 liberty ship loads, or 39,527 2-1/2-ton-truck loads (100 percent overloaded). The 314th has had over 900 rail cars of ammunition moving forward from Pusan and Inchon at one time (68:125).

An illustration of the amount of munitions expended during the Korean War is shown by the following. In one 7 day period in May 1951, 22 battalions used in excess of 300,000 artillery rounds. In comparison, during a 10 day period in December 1944 around Bastogne, 35 battalions fired approximately 94,000 rounds of artillery. The production shortfall of the munitions industry caused worldwide shortages as inventories were relocated to feed the guns in Korea. Production did not catch up with demand until after the signing of the armistice (33:630).

The ammunition shortages experienced during the Korean War can be largely attributed to the following:

1. the unusually high rate of fire deemed necessary to offset the enemy's large numbers of soldiers in particular situations;
2. the fact that no production lines of any consequence were in operation in the United States; and

3. the fact that it took about a year and a half to establish production lines and get volume production ... (33:830).

The concept of a U.S. mobilization base which maintained a state of readiness during peace time, and the importance of maintaining a balance between conventional and nuclear forces, came from our Korean War experience.

World Wars and the Korean War in Comparison

After examining our involvement in World War I, World War II, and the Korean War the evidence shows there is a common thread that links them together: unpreparedness to wage war. Directly tied to the country's lack of preparedness was the lack of adequate funding in the years prior to conflict. The trend that is readily apparent is that between our involvement in the wars we allowed our defense industrial base to decay through lack of capital investment due to the desire of the Nation to fully embrace peace once more. Once it became evident war was inevitable the funding for defense was substantially increased and the race was on to build up the country's industrial capacity.

Although in each instance our industrial might succeeded in producing prodigious amounts of war materials, it took considerable time for industry to build up to peak levels of production. In World War I the peak levels of production were not reached until the final days of the war. We have been fortunate in the past to have time to rebuild our defense industrial base but there is no assurance we will always have that luxury.

Another factor that the World Wars and the Korean War had in common was the use of advancing technology to develop new weaponry for the battlefield. In World War I it was weapons such as the machine gun and motorized vehicles. World War II became known as the war of "mechanized mass" with its overwhelming use of motorized vehicles. World War II technology was also responsible for the development of the atomic bomb, the most destructive weapon mankind has ever known. The Korean war introduced jet aircraft to modern warfare and made further use of the helicopter in combat.

As the use of mechanization in warfare increased, U.S. industry's need for raw materials to build and support the weapon systems increased as well. Petroleum products played an ever increasing role as mechanized warfare became the norm. An illustration of the growing importance of petroleum products in modern warfare is clearly indicated by our experience in the Korean War. During the Korean War an estimated 85 percent of the total supply tonnage shipped to the Far East Command was petroleum products. The amount of gasoline and oil shipped to Korea during April and May 1951 was 4.25 times greater than the tonnage of food supplies and more than 3.54 times greater than the tonnage of ammunition shipped to Korea during the same period.

While technology was responsible for changing the face of modern warfare in each case, it also brought increased lead times. Martin Van Creveld, noted military historian, made the

following comments regarding the increasing use of technology in warfare:

Although coping with the future has never been easy, planners before 1830 at any rate were able to take existing weapons and equipment more or less for granted. During the nineteenth and twentieth centuries this was no longer true, however, and indeed the time was to come when to base one's calculations on available hardware was to invite defeat... The long lead times of up to 15 years that often characterize the most modern technologies in particular mean that most wars have to be fought with the hardware at hand (65:230).

While there were some similarities in our involvement in the World Wars and the Korean War, the dissimilarities are much greater. First, our combat involvement in Korea was declared a "police action" and not a war by the government. Our involvement was under the auspice of a U.N. contingency whose mission in Korea was to restore peace in the area. The benefit of the U.S. operating as part of the U.N. forces as opposed to acting unilaterally in Korea was a potential confrontation between the U.S. and the Soviet Union was avoided. Although we now commonly refer to the conflict in Korea as the Korean War, it is noteworthy that the U.S. never made a declaration of war.

Another difference between the World Wars and the Korean War was that instead of the trial and error approach to mobilization used by the U.S. during the World Wars, a central controlling agency for mobilization was established at the outset of the Korean War. The Office of Defense Mobilization (ODM) was established to serve as policy-setter and coordinating function for the executive agencies involved in

mobilization. The creation of the ODM greatly reduced the confusion and inefficiencies of mobilization control.

The Korean War marked the first time the U.S. established a policy for mobilization and carried it out without an actual war being declared. Planned expansion of the industrial base was accomplished through the mobilization base concept which provided for the preservation of defense industrial capability in times of peace as well as in times of war (86:44).

A conscious decision was made by U.S. leadership to establish an economic policy which would support our involvement in Korea as well as an increased standard of living for the American people. The economic theme for the U.S. during the Korean War became "guns and butter" as opposed to our World War II theme of "guns or butter".

Post Korea

The tensions between the United States and the Soviet Union continued to grow during the years following the Korean War and, as a result, the U.S. made a commitment to maintain a state of mobilization readiness. Mobilization planning continued through the 1950s and new programs and organizations were established to further prepare for the possibility of war. The concept of the "mobilization base" became the dominant mobilization policy. The idea being to maintain an industrial capacity capable of expanding rapidly if needed to meet the production demands of war.

The Department of Defense (DOD) provided the services with guidance for conducting mobilization planning. In order to

for industrial mobilization a method of determining requirements for supplies and equipment is needed. DOD provided the services with Department of Defense Instruction (DODI) 4200.1, 4 April 1954, which standardized the procedure and contained among other things a way for estimating consumption requirements 48 months into the future. Another significant addition to mobilization planning was the Preferential Planning List (PPL). The PPL was a list of military items considered essential to national survival. The DOD issued the PPL to the services and acted as approving authority for including items in the list. The PPL, while proving initially useful, became of little use as time went on due to service lobbying to add more items to the list. Consequently, the number of items on the PPL increased to the point the original intent for establishing the PPL was defeated.

Industrial capacity planning to determine requirements, materials, facilities, skills, and tools necessary for military expansion continued to receive emphasis. The Department of Defense issued directives to procuring agencies to integrate current production with industrial mobilization plans. The main thrust behind the concept was to balance stockpile levels and production capabilities.

As time went on the emphasis on maintaining a balance between nuclear and conventional forces faded. In January 1954, John Foster Dulles, then Secretary of State, outlined the U.S. defense policy of the Eisenhower administration. The

policy was known as "massive retaliation" and relied heavily on the Nation's nuclear capabilities. The program implied that the United States would focus on the source of aggression and not necessarily local hostilities (47:202). The Air Force, convinced the next war would be nuclear, adopted the policy of "Force-in-Being" in 1955. The concept was based on the idea of constant readiness, with established logistic support, to provide deterrence and to provide for massive retaliation capability (32). The action by the Air Force was a contradiction of the essence of the program.

The Air Force conducted no industrial preparedness planning with industry from 1958 to 1967 (13:67). The Navy was also negligent in the area of industrial readiness planning. The Army was the only service to continue active preparedness planning with industry. The industrial sector became confused over the mixed signals it was receiving from the services. Adding to the confusion was the widely known position of the National Security Council on the importance of maintaining a strong conventional capability. Industry felt a lack of support and did not want to invest its money in a program only to later find its efforts were wasted. As a result our conventional capabilities suffered greatly (32).

The policy of massive retaliation under President Eisenhower was replaced by the policy of "flexible response" sponsored by President Kennedy in 1961. The swing of the political pendulum caused the United States to once again seek a balanced approach to mobilization and national defense.

Under the policy of flexible response, the United States was to be in a state of readiness that provided for any scenario that might arise. As a result of the change in national defense policy, industrial preparedness in the United States took on new meaning and had to be rethought.

Vietnam War

The United States involvement in Vietnam was a gradual process. Before World War II, Vietnam, then called French Indo China, had been under French control for nearly 100 years and had two internationally recognized governments North Vietnam and South Vietnam. World War II brought Japanese occupation to Vietnam, and during the war the U.S. supported the efforts of Ho Chi Minh, Communist leader of the Viet-Minh, in harassing the Japanese.

The conclusion of World War II brought about the release of Japanese occupied areas and the French resumed control of Vietnam. However, Ho Chi Minh had other ideas concerning the future of his country. He declared North Vietnam independent of South Vietnam and began fighting the French for control of the country.

Because of treaties with France the U.S. provided the French with weapons and equipment to assist in their attempt to reestablish control of Vietnam. While the French were receiving U.S. aid, Ho Chi Minh was receiving military and economic support from Communist China. The fighting between the French and Viet Minh forces came to an end on 7 May 1954

when the French were overwhelmed by Viet Minh troops during the battle of Dien Bien Phu.

As a result of the Geneva Accords of 1954, which in part established the cease fire agreement between the French and the Viet Minh, American advisory groups were sent to Vietnam to assist with the cease fire arrangements. This marked the beginning of direct U.S. support to Vietnam. A demilitarized zone was created between North and South Vietnam at the 17th parallel and the people were permitted to resettle on whichever side of the parallel they desired (7:8) (57:3).

South Vietnam, under the leadership of Ngo Dinh Diem, was established as the Republic of Vietnam and immediately recognized by the U.S. as the legitimate government. Meanwhile, Ho Chi Minh again declared North Vietnam the Democratic Republic of Vietnam and continued to pursue his objective of unifying Vietnam. The U.S. pledged its support to the Republic of Vietnam and provided military aid primarily in the form of equipment and supplies to assist in fight against unification under Ho Chi Minh.

In August 1964 an attack on U.S. Naval vessels by North Vietnamese torpedo boats in the Gulf of Tonkin changed the role of the U.S. in Vietnam. While controversies still remain concerning the attack, at the time the U.S. responded with retaliatory air raids on North Vietnam (32:159). Our involvement in the war escalated from that point forward.

From the standpoint of industrial mobilization, the United States was again the victim of past mistakes. The industrial

base was not prepared to face the challenge of mobilization. Although immediately following the Korean War there was increased emphasis placed on mobilization preparedness, the emphasis faded as years passed and government policies changed. The industrial base declined significantly. An illustration of the decline is clearly shown by Figure 2 which depicts the increasing age of metal-cutting machine tools during this period. A point Figure 2 fails to establish is the percent of machine tool obsolescence above the normal obsolescence cycle, which was approximately five years in 1960. Leon Koradbil, in assessing the defense industrial base stated in 1960 that "The average age of U.S. cutting machine tools is about 14 years, and this is growing older" (36:38).

By 1964 the Department of Defense had abandoned its mobilization ideas and put into place an all-out austerity program. The Vietnam War could easily be called the "Mobilization That Never Was". The U.S. presence in Vietnam quickly became a political hot potato and, for whatever the reason, the decision was made to support the war effort by "surging" key defense industrial sectors and drawing down war reserves. Because the President decided not to declare a national emergency for the war in Vietnam, the government was limited in what it could do legally to support production of war materials (13:88-9). Consequently, the powers to mobilize the Nation granted to the President in the Defense Production Act of 1950 were scarcely used. This resulted in civilian industries often refusing to take on the manufacturing of

PERCENT
AT LEAST
10 YEARS
OLD

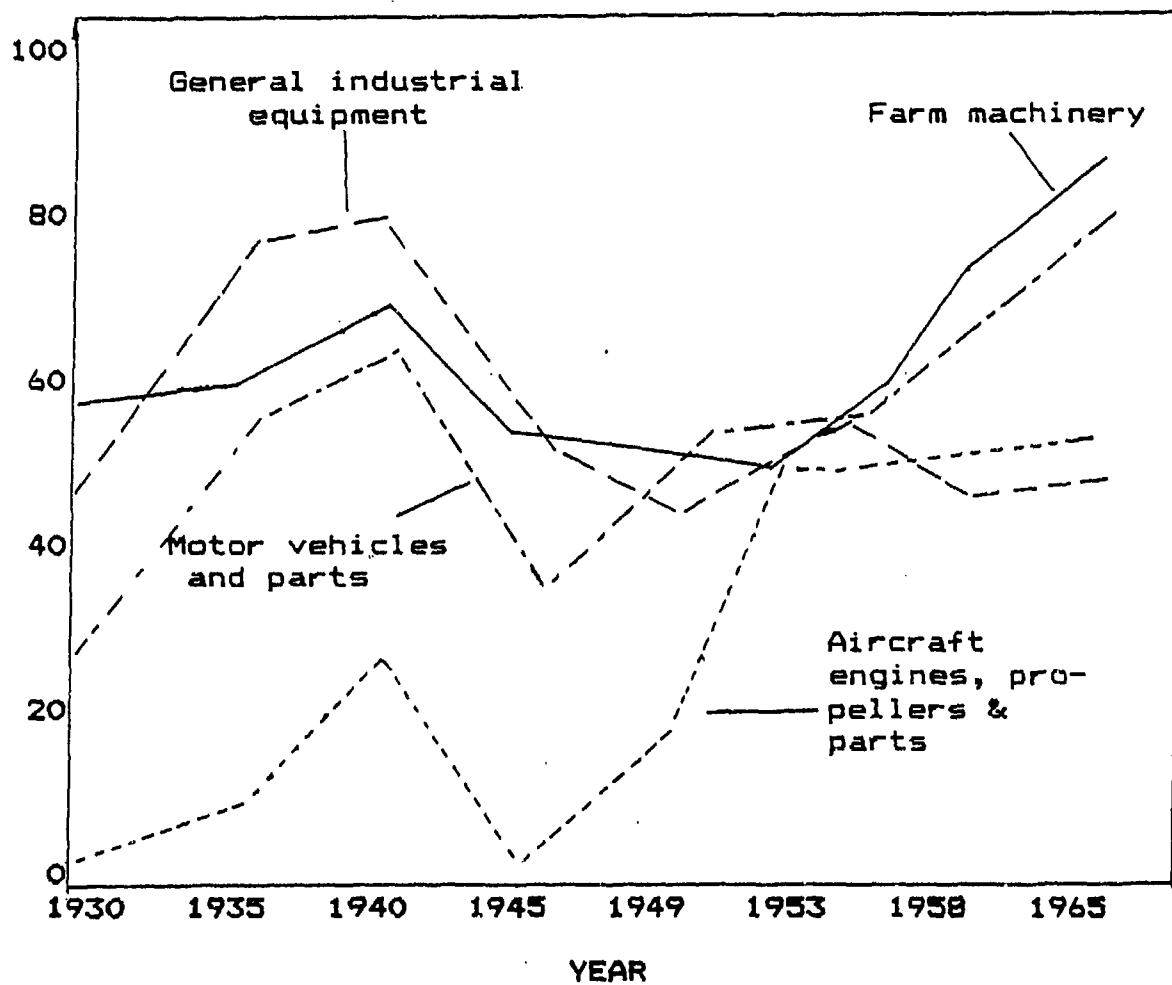


Figure 2. Over-Age Metal-Cutting Machine Tools, Selected Industries, Projected in 1965 (38:84)

defense related items because it would interrupt their civilian business. Colonel Jesse G. Mulkey commented the problem in his article, *Defense Acquisition and Improved Responsiveness of the U.S. Industrial Base*:

War production for the Vietnam conflict was so intertwined with continued emphasis on the civilian economy, that mobilization in the traditional sense was not instituted or seriously considered (44:53-59).

The U.S. fought Vietnam as a "limited war". Conceptually, a limited war is "something less than all-out conventional war. . . which could mean any non-nuclear conflict regardless of scope and duration" (13:68). The Office of Emergency Planning in July 1966 developed a Resource Mobilization Plan for Limited War. This Plan marked a return to planning for conventional war. There was concern by U.S. leadership over the cost of funding the war in Vietnam. The decision to fight a limited war in Vietnam carried with it changes in the way war was funded. Funding for war prior to Vietnam was more less a "blank check" approach and the responsibilities of financial management amounted to keeping records of how money was spent without really being concerned about budgeting expenditures. However, the concept of limited war, with its less than total mobilization of the Nation's economy, called for prudent use of resources and this meant budgeting funds to the best extent possible (57:4).

In an attempt at lowering the cost of funding the war the decision was made to switch from using current procurements, which was the policy established in the 1950s to maintain mobilization capability, to using competitive procurements.

One significant impact of the change was that it placed production of war materials and production of consumer goods on equal footing. This caused problems because industry had no incentive to shorten lead times for military items or, for that matter, to give them a higher priority than production of civilian goods. As a result, production of items such as engines, transmissions, and axles went largely to the commercial sector. The lack of production capacity to support both military requirements and civilian needs served to place the military services in competition with one another striving to obtain the equipment and supplies needed to support their war efforts (13:70).

Of all the production problems encountered during the Vietnam war none were more serious than those of munitions production. One author noted the following:

The situation discovered in 1965 was actually worse than encountered in 1950. Nothing had been done to update the facilities, let alone maintain them. Millions had to be spent to bring the plants back into production (13:70).

Compounding the problem was the fact that authorized ammunition expenditures for Vietnam had been formulated largely from historical data produced from our World War II and Korean War experience. However, consumption rates exceeded the authorized rates as operational concepts dictated new, larger ammunition expenditure rates. There were recorded instances of units expending more munitions in one or two months than the total expended by their counterparts during World War II (47:254). Consequently, a drawdown of reserve ammunition stocks was required to meet the demands of the war.

The lack of adequate munitions facilities at the outset of the war coupled with the drawdown of ammunition reserves resulted in some munition shortages throughout the. In 1965 only 11 of the Army's 25 munitions plants were operational. Action was taken early in the war to activate the other ammunition plants and six were activated in 1966 followed by six more in 1967. By 1968 all but one of the Army's munitions plants were operational. As the munitions plants were activated the amount of munitions shipped to Vietnam increased dramatically. In 1966 the average monthly munitions shipment to the Army in Vietnam averaged nearly 40,000 short tons. In 1967 the monthly amount shipped increased to 75,000 short tons and by 1968 it had reached about 90,000 short tons per month. The increase in munitions production for the Vietnam War is reflected in terms of dollars in Table 23.

Table 23.
Army Munitions Programs, Fiscal Years 1965-1970
(in millions of dollars) (32:119)

<u>Fiscal Year</u>	<u>Army Total</u>	<u>Army Vietnam</u>
1965	\$ 338	\$ 305
1966	\$ 1313	\$ 853
1967	\$ 1328	\$ 1007
1968	\$ 2328	\$ 2206
1969	\$ 2813	\$ 2719
1970	\$ 1731	\$ 1456

The shortages experienced by U.S. forces during the Vietnam War were not limited to munitions, but included a variety of equipment and supplies. At the onset of the war there was a shortage of tropical combat uniforms and tropical

combat boots as production of these items lagged behind the mobilization of our fighting forces. In 1965 the Army's policy was to issue individuals deploying to Vietnam with four utility uniforms and two pairs of leather boots with the tropical combat items being issued to the individual in Vietnam. It took until August 1967 before production rates of these items were sufficient enough to issue personnel bound for Vietnam with tropical combat gear (32:46).

Another example of a shortage in Vietnam involved artillery units and the lack of 175-mm. M113 gun tubes for the M107 Self-Propelled Gun. The M107 was introduced into Vietnam by U.S. forces in 1965. The high rate of fire of the M107 was consuming gun tubes on the average of one every 45 days, which was much faster than expected. The high consumption rate of gun tubes demanded they be transported to Vietnam by airlift from the U.S.. It was not until December 1967 the Army attained enough stockage of gun tubes in Vietnam to stabilize the situation (32:46).

The shortages experienced by U.S. forces in Vietnam can be attributed for the most part to the decision not to mobilize the U.S. industrial might in support of the war. However, there were other contributing factors as well. A vital part of supporting fighting forces engaged in war calls for the realistic determination of requirements for equipment and supplies. In the initial planning for our combat involvement in Vietnam it was assumed the war would be over by 30 June 1967. Consequently, budgets and procurement contracts were

based on the assumption of a short-war. This short-war assumption caused many U.S. manufacturers to shy away from accepting defense contracts because they estimated peak production rates would be achieved as the war was winding down and the need for their product would diminish leaving them holding the bag from an economic standpoint (47:230).

Another factor contributing to the problem was the "No Buy" restriction put on the procurement of major items of equipment, by the Office of the Secretary for Defense, for units to be manned only during the war in Vietnam. The restriction resulted in certain units being forced to borrow equipment which had been bought for other units or getting the needed equipment from reserve stocks. In either case the restriction caused shortages and a reduction in force readiness (32:29).

Sole sourcing of military items, which were usually specialized high priced items, added to problems of supplying sufficient quantities for the war effort. In many cases manufacturers were not willing to make the capital investment required to expand their facilities and, consequently, production rates could not support the rapidly rising demand of our fighting forces in Vietnam (32:29).

Without the means to deliver military equipment and supplies to the forces needing them all the production capability in the world is of little use. A war, such as Vietnam, fought thousands of miles from the U.S. increases the importance of transportation. With modern technology, our

military ability to carryout national policy becomes almost totally dependent on airlift and sealift. At the start of the Vietnam War the U.S. had a small Merchant Marine fleet and a Military Sea Transportation fleet (MSTS) which was made up of 88 vintage World War II ships. Through a variety of actions, such as contracts with commercial shippers, charters with foreign lines, and activation from the National Reserve Fleet, the MSTS was able to acquire some 500 ships which proved to be enough to support our needs (47:238). It should be emphasized that our sealift experienced no threat from the North Vietnamese.

Vietnam posed many logistical problems for U.S. forces. A major and significant problem was the lack of ports with deep water piers. Adding to the problem was the fact that tugboats and barges were virtually nonexistent. Even if there had been adequate docking facilities the movement facilities and transportation required to distribute the equipment and supplies from the dock were insufficient to accomplish the task. It took massive construction projects and procurement of large amounts of equipment to correct the problem. During the early stages of the war, before the completion of the construction projects and procurements, ships often had to wait in harbor for two or more months before they were offloaded (47:240).

Airlift was the primary means of U.S. troop transportation to and from Vietnam. This service was provided either by Military Air Transport Service (MATS) or flights chartered from

United States commercial carriers. Although there was a shortage of available aircraft, the military was not authorized to call up the Civil Reserve Air Fleet (CRAF) and had to rely solely on contracts and charters to provide any extended airlift required (47:242).

By 1970 concerns about future U.S. defense industrial capability began to surface from various sources. The President of the National Security Industrial Association expressed his concern in a letter to President Nixon in September 1970 in which he stated "unless some mobilization base planning is factored into the cutbacks in defense programs, many essential technical and production facilities in industry will cease to be available" (13:71). Also concerned about the defense industrial base was the Industry Advisory Council (IAC). The IAC was a group of 24 representatives from industry who met quarterly with the Secretary of Defense to discuss issues concerning the industrial base. As a result of the IAC's concern the Secretary of Defense tasked an IAC subcommittee in November 1970 to evaluate the condition of the U.S. industrial base as well as current mobilization base planning. The subcommittee issued its findings in June 1971. Their findings included the following:

1. Out of the 88 industries examined in terms of the employment impact of the buildup for Vietnam between 1965 and 1968, only six industries had accounted for 47 percent of the 1.4 million jobs created by the effort, with three of those—ordnance, transportation, and aircraft—accounting for 38 percent of the increase.
2. By 1971 there had been a decline to a level approximating that existing in 1965.

3. There was a high concentration of professional and craft skills in the industries in decline.
4. There was a severe instability in such crucial areas as helicopter production, naval production facilities, and aircraft plants (13:71).

The Committee attributed the lack of effective mobilization planning to the "failure to give such planning continuous and strong emphasis over the years" (13:72).

Another report of note was issued by the Joint Logistics Review Board (JLRB) in 1970. The Board's report was an evaluation of the logistical support provided to U.S. forces during the Vietnam War. The findings of the Board further confirmed the doubts expressed by some concerning the ability of the U.S. industrial base to support future military conflict.

One finding of the JLRB addressed inadequate national capacity to support industrial mobilization. Citing the production of miniature and instrument ball bearings as one industry with inadequate capacity the JLRB reported that in 1969 there were only three major producers, and two of them were in danger while the third had been sold to a Japanese manufacturer. The JLRB made a prediction in its report which has turned out to be a prophecy; the growing U.S. dependency on foreign sources for weapon system components (13:53).

Another finding of the JLRB was that mobility planning between the Government and industry was not adequate. One participant in the study, the Machinery and Allied Products Institute, stated that involvement in mobilization planning with the Government was only an exercise. The plans were

obsolete; moreover, the yearly quantities specified could be produced in only a few days. The Institute further commented that "Industrial Mobilization Planning needs major attention. Our nation's strength relates to our industrial capacity. Strategic planning must relate to this strength" (86:55).

A point which must be included in the review of our Vietnam experience is the influence the U.S. public brought to bear, especially during the later years of the war as public sentiment became more negative. Not only was public opinion a factor in political decisions concerning the war, but it often influenced an industry's decision to accept or not accept defense contracts as well. Many industries were not willing to bear the wrath of public opinion and declined all war related contracts.

In the final analysis it was the decision not to declare a national emergency and mobilize the nation during the Vietnam War that was responsible for the U.S. fighting the longest war in its history with virtually a peacetime economy.

Lessons Learned-Vietnam War

1. The support of the public is essential for the U.S. to effectively wage war. Our Vietnam experience proved that without the backing of the American people an attempt to engage in war is doomed.
2. In addition to public support the industrial might of the Nation is required to support our military forces as they support our national objectives. Once the decision is

nade to engage in war it is imperative a national emergency be declared and the industrial base mobilized.

3. Again, it was demonstrated it takes less time to mobilize our military forces than it does for industry to reach production rates of war materials required to support a war effort. Careful management of resources, withdrawing assets from low priority organizations and redistributing them to high priority organizations, will help alleviate shortages.
4. Our industrial base is an asset and should be treated as such. This means we must provide capital investment for expansion and modernization as well as providing for on-going maintenance of the facilities.
5. To be effective industrial mobilization planning must be a partnership between Government and industry with each committed to development of a realistic plan which will allow the industrial base to mobilize as quickly as possible if called upon.
6. It is essential we maintain adequate stockpiles of munitions to sustain our forces until munitions production can be brought on line.

World Wars, Korean War, and the Vietnam War in Comparison

The Vietnam War began for the U.S. in the same manner as the World Wars and the Korean War with the supplying of military aid in the form of equipment and supplies. Another similarity between Vietnam and the other wars was that once again the U.S. was not prepared to fight a war. The military

forces were greatly reduced during the post Korean War years and the industrial base required to support our military forces was not maintained. We failed to learn many of the lessons of industrial mobilization from the World Wars and the Korean War; a fact clearly demonstrated during the Vietnam War.

The importance of petroleum products to modern warfare continued during the Vietnam War (See Table 24) as the mechanization which characterized World War II and the Korean War was further expanded. Some of the factors which led to the high consumption rates of petroleum by U.S. forces during Vietnam include:

1. the use of high-performance Air Force and Navy Aircraft;
2. the use of B-52 aircraft for conventional bombing;
3. extensive use of fixed wing and helicopter aircraft for logistics purposes, including medical evacuation;
4. extensive use of many forms of powered equipment such as river craft, harbor craft, and so on;
5. naval ships of the Pacific Fleet;
6. huge inventories of road vehicles for personnel and logistics problems (47:257).

Table 24.
Petroleum Consumption - U.S. Army - Vietnam
(32:73)

<u>Year</u>	<u>Barrels</u>
1964	2,700,000
1965	6,875,000
1966	21,850,000
1967	36,280,000
1968	48,850,000
1969	41,785,000
1970	38,450,000

The U.S. involvement in the Vietnam War was unique in that it was fought without the declaration of war or a national

emergency and without the benefit of the nation's industrial might directed to war support.

Post Vietnam War

Since the Vietnam war there has been growing concern regarding the condition of the defense industrial base and its capability to mobilize if called upon. One of the first indications of a problem occurred in 1973, when "the U.S. was unable to increase its production of tanks to replace those lost by Israel during the Arab-Israeli War" (8:25). The limiting factor proved to be a shortage of suitable casting capacity for tank turrets and hulls. The ability of the defense industrial base to meet the production demands of war has since come under scrutiny. In 1976 a report by the Defense Science Board Task Force on Industrial Readiness concluded:

. . . the United States is presently deficient in the extent to which the defense industrial base is postured to provide material support to the forces in response to the full spectrum of potential conflict situations upon which our national security plans are based (60:9).

Increased interest in the capabilities of our defense industrial base prompted a Congressional investigation in 1980. The findings of the investigations were published in a document that has become known as the "Ichord Report" after Representative Richard H. Ichord who chaired the investigation. The findings of the investigation included the following:

1. the defense industrial base has deteriorated and is in danger of further deterioration;
2. the DOD has neither an on-going program nor a plan to address the problem;

3. instability, weapon system stretchouts, inadequate budgeting, and inflation have led to this condition;
4. shortage of critical materials and dependence on foreign sources jeopardize the foundation of our capabilities;
5. present procurement policies and procedures by the DOD are excessively inflexible;
6. current tax and profit policies appear to discourage capital investment which would improve the defense industrial base;
7. no single point of responsibility for the condition of the defense industrial base, which has led to a serious lack of long term planning (80:23).

The findings of the Ichord Panel have as much relevance now as they did when nearly ten years ago.

Others have echoed their concern about the industrial base. Roy T. Marr, who offered his assessment of the decline of the industrial base in an article for *Army Logistician*, said:

It is apparent that during the last 30 years, the United States has been a post-industrial nation, diverting more and more resources into service and information management evolution, combined with various acquisition policies and practices within the DOD and inadequate incentives for investment in capital equipment, has led to a deterioration of the DOD industrial base (38:26).

It is clearly documented, and has been for some time, that our industrial base is seriously declining. The driving factor behind the demise is the state of the world economy since the end of World War II. At the conclusion of the war the United States emerged as the industrial giant of the world. Since the end of the war many countries, such as Japan, Germany, and Korea, have rebuilt their economies and have achieved great success competing in the global market. Meanwhile, the United States has been losing its claim on much of the marketplace.

Penetration of our industrial base by foreign competitors poses a serious threat to many U.S. companies involved in defense critical manufacturing areas. Particularly this is true for the semiconductor, electronics, and basic industries. The result of this competition has left . . . "the United States woefully dependent upon foreign sources for many components in its defense systems" (58:16). Table 25 list some of our weapon systems which require foreign semiconductors in order to function.

Table 25.
No Choice But Foreign Chips
(58:16)

-
1. Global Positioning System (satellites)
 2. Integrated UnderWater Surveillance Systems
 3. Defense Satellite Communication System
 4. Fleet Satellite Communications System
 5. SSQ AN-53B Sonobuoy
 6. F-16 Fighting Falcon
 7. AIM-7 Sparrow Air-to-Air Missile
 8. AM-8988 Poet (expendable jammer)
 9. Army Helicopter Improvement Program (OH-58 Kiowa)
 10. APG-63 Airborne Radar (for the F-15 Eagle)
 11. M1 Abrams Tank
 12. F/A-18 Hornet
-

The cause of our foreign dependency for semiconductors is the loss of marketshare by U.S. manufacturers of semiconductors. The U.S. share of the worldwide semiconductor market declined from 60 percent in 1975 to 49 percent in 1985, while the Japanese share of the market increased from 20 percent in 1975 to more than 50 percent in 1986 (22:49).

The loss of the U.S. market share of the "dynamic random-access memories" (DRAMs) sector of the semiconductor industry

is even more devastating. DRAMs represent the state of the art in the semiconductor industry . . . "they are the most challenging to manufacture competitively and their development establishes the pace for progress in semiconductor technology" (22:49). In 1975 the U.S. owned 100 percent of the world marketshare for DRAMs it has since declined to less than 5 percent.

The seriousness of our foreign dependency for semiconductors cannot be over stated:

A recent Joint Commanders study suggested that a total cutoff of foreign sources would almost immediately halt production of key weapons, such as the M-1 Abrams tank, the AIM-7 Sparrow air-to-air missile, sonobuoys, the OH-58D Kiowa helicopter, the F-16 Falcon and the F/A-18 Hornet fighter for periods ranging from six to fourteen months after as few as two months of surged production. (58:17).

In 1987 the Defense Science Board was tasked with evaluating the impact of U.S. foreign dependency for semiconductors on our defense capabilities. The findings of the Board included the following:

1. U.S. military forces depend heavily on technological superiority to win.
2. Semiconductors are the key to leadership in electronics.
3. Semiconductor technology leadership, which in this field is closely coupled to manufacturing leadership, will soon reside abroad.
4. Defense will soon depend on foreign sources for state-of-the-art technology in semiconductors (22:48-52).

A question that begs asking is "Why did we wait until we had virtually lost the semiconductor industry before conducting an investigation of its contribution to national defense?" It is the opinion of this researcher that the government hesitated

to take action primarily because it did not want to interfere with the marketplace and chose instead to employ a laissez-faire policy and hope for the best.

The Defense Science Board made a number of recommendations for reviving the U.S. semiconductor industry, including:

1. Establishment of a Semiconductor Manufacturing Technology Institute (SEMATECH). A public-private venture for improving the manufacturing base. The facility would serve a quasi-captive function as the principal supplier to DOD.
2. Setting up centers of excellence for semiconductor science and engineering at eight universities.
3. Increasing DOD research and development in semiconductor materials, devices, and manufacturing infrastructure (22:53).

The Government has started to respond to the semiconductor crisis and, as a result, a number of recommendations made by the Defense Science Board are in various stages of being implemented including the establishment of SEMATECH, which has received strong Congressional support.

The issue of foreign penetration of U.S. markets is not limited to the semiconductor industry, but cuts across a wide variety of U.S. industries. One industry severely affected by foreign competition is the machine tool industry. This is especially critical because U.S. mobilization efforts have been plagued by shortages of machine tools since World War I. During mobilization the lack of adequate machine tools has to be a bottleneck in U.S. efforts to expand production capabilities.

In spite of this knowledge, the Government allowed foreign penetration of the U.S. machine tool market to proceed until it was determined by the Department of Commerce in 1988 that a

petition, filed by the National Machine Tool Builders Association (NMTBA) in 1983, was correct in its claim that foreign penetration of the machine tool market had impaired national security (22:43).

The petition submitted by the NMTBA to the Department of Commerce clearly indicated the effect of imports on the U.S. machine tool industry. "Imports have grown from a 16.5 percent share of the U.S. market in 1977 to 27 percent in 1982 measured in value terms" (22:42). The import share grew to 49 percent of the U.S. market in 1986. Imports of machine tools had such an impact on U.S. machine tool makers that 25 percent of the U.S. machine tool companies operating in 1983 had either closed, been bought out, or moved their production offshore by 1986 (58:41). A serious result of this situation is the loss of skilled workers, and the lack of trainees interested in learning what is perceived as a dying a U.S. trade.

The Government took action in 1986, three years after the NMTBA had filed its petition. In 1986 the U.S. made a five year Voluntary Restraint Agreement (VRA) with the four top U.S. importers of machine tools, Japan, West Germany, Switzerland, and Taiwan. The agreement calls for those countries to limit their exports of high-tech machine tools to the United States. Additionally in 1986, the Government responded with the Machine Tool Domestic Action Plan to help revive the industry during the five year VRA. Provisions of the Plan include:

1. Budgeting \$5 million to support the National Center for Manufacturing Sciences (NCMS), a private research and development venture sponsored by machine tool makers and other manufacturers founded in 1986...

2. Designating the machine tool industry as a separate area of interest under the DOD Manufacturing Technology (MANTECH) program.
3. Sponsoring a government/industry conference to define potential machine tool research projects to improve manufacturing technology (58:42).

While the full impact of the actions taken by the Government to resurrect the U.S. machine tool industry will not be clear until 1991 when the VRA is lifted, the initial indications have shown promise. Foreign market share of the U.S. machine tool industry had declined to 30 percent in 1987 after being nearly 50 percent in 1986 and orders placed to U.S. manufacturers of machine tools have been steadily increasing (22) (58).

Another aspect of machine tools that directly affects U.S. industrial mobilization is the Machine Tool Reserve Program. The purpose of the program is to stockpile machine-tools to be used in case of a national emergency. The current machine tool reserve is primarily made up of World War II and Korean War era machine tools. The average age of metal-cutting machine tools in reserve in 1981 was over 28 years and the average age of metal forming machine tools in reserve was 25 years. The average machine tool in the U.S. stockpile in 1984 was manufactured in 1955.

Further assistance in getting the machine tools required to mobilize the U.S. industrial base is supposed to come from the Machine Tool Trigger Program. This program was designed to furnish U.S. machine tool manufacturers with mobilization requirements for general purpose machine tools which would then be "triggered" automatically to U.S. defense industries during

a national emergency. The concept was first used during the Korean War as part of the plan for overcoming the U.S. machine tool shortage, and was known as the M-Day Pool Order Program.

As part of their report on the condition of the U.S. machine tool industry the NMBTA reported that:

Realistic defense scenarios were used to estimate derived demand for categories of machine tools. When demand and supply estimates were compared under widely accepted contingency assumptions, the availability of machine-tools was inadequate for support of emergency defense requirements. Furthermore, it was found that the Machine Tool Reserve is obsolete and that the trigger program is not effective (22:41).

While there is growing alarm about foreign dependency and the effect it may have on the ability of the United States to mobilize its industrial base in time of national emergency, there are those who believe the free-market should reign and the Government should not get involved. There are also those who believe, in this day and age foreign dependency by the U.S. on some scale is inevitable, and acceptable, given the current state of the world economy. Joesph E. Muckerman II and James Miskel in their article *Mobilization: Neglected Bulwark of National Security*, commented:

In today's economy, North American autarky is unattainable given the proficiency of our trading partners and allies. . . it may not be physically possible for the United States to manufacture everything it would need to prosecute a major conventional war (43:38).

The authors go on to discuss the complexities of the modern world with regards to industrial production and reach the conclusion that:

In the brave new world of the global economy, industrial production is too complex and involves too many intermediate producers, and world-wide investment decisions are made too quickly for any government to effectively manage or even monitor (43:38).

One premise of the article is that in order for the U.S. to offset the Soviet Union's numerical superiority of weapons with fewer, but qualitatively superior, weapons requires that we get the most for our defense dollar. The idea is to buy from the lowest cost producer, providing his production meets the required specifications, regardless of geographical location. The authors state that "buying from higher cost producers reduces the number of units that can be purchased . . . and shifts resources away from research and technological innovation" (43:38).

The article does not suggest that buying from the lowest cost producer be done for every item but, rather that it be done selectively. A plan outlining what items would qualify for selective purchase and how to identify them is not presented in the article nor is the potential loss of U.S. manufacturing capacity due to the decision to purchase offshore addressed. The author's conclude:

. . . it would be unrealistic, and inadvisable economically, politically and possibly militarily for the United States to try to become fully self-sufficient in defense production. Autarky is simply not an achievable or desirable policy in a global economy (43:38).

While the authors' contention may well be true, and warrants further investigation, the solution they offer could be a two edged sword. If through low cost purchases we selectively lose U.S. industrial capability, we may find during

a national crisis that we have lost essential industrial capacity which could prove devastating.

Foreign dependency is an on-going issue which touches many aspects of U.S. industrial mobilization. One aspect is raw materials. The U.S. is a country rich in natural resources but there are a number of raw materials for which we depend on foreign sources. The importance of raw materials was realized in World War I and a stockpile started. World War II with its mechanized mass increased the importance of the stockpile and, as a result, Congress passed the Strategic and Critical Materials Stockpiling Act of 1946. The role of the stockpile has been debated ever since with critics alleging that the stockpile has been misused for reasons not related to national security, such as favoring business interests (22:15).

What is not debatable is the current state of the stockpile. "The stockpile is presently out dated and possesses many minerals that no longer have mobilization value" (58:30). Many minerals in the stockpile are overstocked (See Table 26), while many remain understocked (See Table 27). The total value of overstocked raw materials as of 30 September 1987 was \$2.1 billion, while the shortfall of raw materials of the same date was \$10.4 billion (58:32-4). Current Government policy calls for the national stockpile to be configured to support U.S. industry for up to three years in the event of a national emergency. The present stockpile falls far short of that goal.

The quantities of raw materials required for industry to produce the machinery of war is substantial. Table 28 depicts

the estimated amount of various metals required for the manufacturing of one F-15 or F-18 jet engine. All of the metals listed in Table 27 are on the shortfall list with seven of the eight being primarily supplied by foreign sources.

There appears to be two principle reasons for the current condition of the stockpile. First, there is uncertainty about what raw materials U.S. industry would require in time of mobilization. Second, there is reluctance on the part of the Government to spend the billions of dollars it would require to configure the national stockpile to its mandated levels (22) (58).

Table 26.
A Partial Listing of Excesses in the Stockpile Inventory
(as of 30 September 1987) (58:32)

<u>Raw Material</u>	<u>Excess in \$Millions</u>
Tin	940.6
Silver, Fine	863.0
Tungston	75.0
Vegetable Tannin-Quebracho	73.0
Mercury	49.0
Silicon Carbide-Crude	23.0
Thorium Nitrate	22.0
Diamond-Industrial Group	15.0

There are currently 93 raw materials authorized for stockpiling. It seems apparent from the current configuration of the stockpile that some form of logical management needs to be applied. It also appears the stockpile will not be funded to the mandated levels anytime soon. Therefore, a priority system needs to be developed for obtaining those raw materials which are most critical in support of U.S. industry.

Table 27.
A Partial Listing of Shortfalls in the Stockpile Inventory
(as of 30 September 1987) (58:32)

<u>Raw Material</u>	<u>Excess in \$Millions</u>
Copper	1,894.3
Aluminum Metal Group	1,610.4
Titanium Sponge	1,360.3
Zinc	1,004.8
Rubber	878.5
Nickel	802.9
Platinum Group Metal-Platinum	508.7
Lead	440.0
Bauxite-Refractory	275.0
Platinum Group Metal-Palladium	230.0
Cobalt	220.0
Aluminum Oxide-Abrasive Grade	180.0
Chromite-Refractory Grade Ore	48.0
Chromium-Chemical & Metallurgical	46.0
Columbium Group	15.0

Table 28.
Metals in the F-15/F-16 Aircraft Engine
(58:36) (22:89)

<u>Metals</u>	<u>Requirements/lbs</u>	<u>Primary Source: U.S./Foreign</u>
Aluminum	1,000	U.S.
Chromium	2,000	Foreign
Cobalt	1,200	Foreign
Columbium	200	Foreign
Manganese	23	Foreign
Nickel	4,500	Foreign
Tantalum	3	Foreign
Titanium	5,200	Foreign

The International Economic Studies Institute published a book, Raw Materials and Foreign Policy (22:16), which addresses the problems of balancing the stockpile. The book brings out that it is not currently feasible to realistically manage the 93 authorized raw materials in the stockpile and

suggests there are a limited number of raw materials, approximately 24, whose stockage warrants close management.

Foreign dependency has the potential to transition into vulnerability and, consequently, the Institute sees the stockpiles of those raw materials for which the U.S. is dependent on foreign sources as ". . . cost effective insurance policies. . ." (22:17). Raw materials such as cobalt, chromium, manganese, and platinum are good examples of raw materials we should stock to the authorized levels because of our great foreign dependency for them. In 1986 we imported 92 percent of our cobalt, 82 percent of our chromium, 100 percent of our manganese, and 98 percent of our platinum (22:88).

The dependency of the U.S. on petroleum products cannot be denied. The impact on American society by the oil embargo of 1973, and again in 1979, certainly made that point clear. After the crisis in 1973, Public Law 94-163, the Energy Policy and Conservation Act of 1975, was enacted. The purpose of the Act was to establish a Strategic Petroleum Reserve (SPR) of up to one billion barrels to offset any future reduction of the U.S. oil supply. The current goal of the SPR is 750 million barrels which is estimated to be reached by the year 2004 at the present rate of fill, which is approximately 29 million barrels a year (58:38).

The possibility of another oil crisis looms large on the horizon. In 1976 with the virtual collapse of oil prices U.S. oil companies drastically reduced their investment in

exploration and drilling. A 1987 report to the President by the Department of Energy concluded:

lower U.S. oil production increases imports. . . raises the demand for OPEC oil, and Persian Gulf oil in particular and increases the likelihood and potential severity of future disruptions in the oil supply (22:25).

It has been predicted by some analyst and commentators that by the 1990s OPEC will again reign over the world's oil market. And, indeed, it is entirely possible with our current level of imported oil at approximately at 8 million barrels a day: a figure representing almost one-half of our present consumption, which means we are currently more dependent on foreign oil than we were during the 1973 oil embargo.

An example of what heavy dependence on foreign oil can translate into was illustrated in 1986. The U.S., seeking approval from our Western European allies for our counter-terrorism airstrikes against Libya, received no support. One reason for the lack of support was Italy, France, West Germany, and Spain had been receiving 262,000, 49,000, 205,000, and 66,000 barrels of oil a day respectively from Libya. While those levels represented only a fraction of each country's daily petroleum requirement, the amounts were significant enough that Western Europeans thought avoiding offending Libya was more important than supporting the actions of an ally (30:327).

Petroleum has been essential to modern warfare since the mass introduction of mechanization in World War I. Its impact on the battlefield has continued to increase over time. The amount of petroleum needed to sustain the nation's military

forces has increased dramatically over the years. Current U.S. forces require an estimated 500,000 barrels of petroleum per day (See Table 29) without considering wartime needs, which will certainly be much greater. That figure is nearly equal the amount of petroleum required by American forces during last days of World War II (See Table 30) (30:333). It becomes readily apparent just how petroleum dependent our fighting force has become when the current force structure is compared with that of World War II. U.S. forces totalled some 12.2 million personnel in 1945. Current military strength is only 2 million people. Yet, our present forces require nearly the same amount of petroleum to sustain them as did their much larger predecessors in World War II.

Table 29. U.S. Military Peactime Petroleum Requirements (1986) (30:333)	
<u>Service</u>	<u>Barrels per day</u>
Air Force	279,330
Navy	152,490
Army	41,180
Marine Corps	11,150
Total	484,130

Petroleum is the lifeline of modern warfare and without an ample supply of it winning any war less than a nuclear war is virtually impossible. In the event of a war of any magnitude consumption of petroleum by U.S. military forces can be expected to double or possibly triple (30:333). That makes

the issue of U.S. foreign dependency of oil loom even larger in defense planning than it already does. It also adds that much more importance to the SPR and the need to seek means to reduce petroleum consumption.

Table 30.
U.S. Military Consumption 1940-1945
(30:333)

<u>Year</u>	<u>Barrels per day</u>
1940	14,252
1941	28,642
1942	92,910
1943	207,749
1944	431,289
1945	520,523

Strategies for reducing our dependency on foreign sources for oil are varied and evoke varying degrees of controversy. The Synfuels Corporation established by the Government to develop synthetic sources of fuel has lost much of its priority since the decline of oil prices. Consequently, funding for its research projects has been cut.

Another alternative for decreasing our dependency on foreign oil is the development of the Naval Oil Shale Reserves. The Reserves are undeveloped land forms which contain oil-bearing shale. It is currently considered uneconomical to process the shale and, consequently, there are no immediate plans for development of the Reserves (58:36).

The alternative to reduce U.S. petroleum consumption through tax assessment is perhaps the most controversial of all the alternatives. Proponents of placing a larger tax on

gasoline believe the tax would serve to reduce petroleum consumption, reduce the Federal budget deficit, and prove beneficial to the environment. It has been estimated that a 25 cent tax per gallon of gas would bring in annual revenues of up to \$40 billion as well as reduce our dependence on OPEC for oil (22:28).

Basic industries, such as the steel, forging, bearings, and gears are the backbone of the U.S. defense industrial base. Without these key industries it is virtually impossible to produce the numbers of tanks, aircraft, missiles, artillery, heavy trucks, naval vessels, and submarines required to fight a war.

An illustration of the importance of our basic industries to the defense industrial base was seen in 1973 when the Army requested Chrysler, the primary contractor, to accelerate production of the M80 tank from 30 tanks a month to 100 tanks a month. Chrysler was only able to respond with 40 tanks a month because there were only four active foundries in the United States with the capacity to produce the hulls and turrets needed for the M80. Each of the four active foundries had a heavy commercial supply of backorders and were reluctant to cut into their commercial business to produce hull and turret castings which provided a low profit margin while requiring a large portion of a plant's capacity (48:8).

After extensive contract negotiations two of the four foundries agreed to supply the castings, but only after the Army agreed to fund the capital investment needed for

production expansion. The Army paid the two foundries in excess of \$18 million to expand their production capabilities and invested \$11 million more in the their own tank plant in Detroit (45).

In 1981 the closing of one of the foundries with the capacity to cast hulls and turrets once again placed the production base for main battle tanks in jeopardy. The closing of the foundry reduced the maximum production capacity for the M80A3 tank to approximately 80 a month (45:11).

America's foundry industry, which supported the production of some 20,000 tanks a year during World War II, has deteriorated to the point the capacity to support the production of even hundreds of tanks a year is questionable.

The decline experienced by the foundry industry is not unique to that industry but has been shared by all of our basic industries. An example of another basic industry in decline is the forging industry. The forging process imparts strength and toughness in metals that is not possible through other means of fabrication. The following represents a small sample of military equipments which require forgings:

1. The M-80 battle tank depends on at least 585 separate forgings at critical points of shock and stress.
2. The M-113 Personnel Carrier depends on at least 250 forgings.
3. The 2-1/2-ton and 5 ton military trucks have 50 and 75 forged components each.
4. 250-pound and 500-pound bombs each contain seven forgings.
5. The majority of 155mm, 75mm, and 3-inch shells and mortar projectiles contain at least two forgings each.
6. An F-15 has approximately 1,700 forgings in the airframe and its components, 78 in its landing gear, and about 2,500 in each of its two F-100 engines. (35:315).

The obvious importance of the forging industry to the U.S. defense industrial base unfortunately does not prevent the industry from becoming an endangered species. Domestic production fell from 1,150,000 tons in 1979 to 700,000 tons in 1985; which is nearly a 40 percent reduction. Out of the less than 400 forging plants in operation prior to 1979, 76 of them went out of business between 1979 and 1988. The closing of those 76 forging plants translates into the loss of 10,000 people whose skills will be lost to the industry as they seek other means of employment. Meanwhile, the forging plants remaining in operation work well below full capacity (35).

The reasons for the decline of the U.S. forging industry can be applied to virtually all of our basic industries. Foreign competition is the principle cause for the decline. What has occurred over the years that has made our basic industries less competitive in the world market? First, the inflationary pressures of the 1970s caused production cost to increase. The cheapest grade forging materials that could once be purchased for 10 cents a pound have now more than doubled in price. The increased cost of labor has also had an impact on the ability of U.S. industries to be competitive. Labor cost in the forging industry which averaged \$3-4 an hour ten years ago now averages \$12 an hour. Finally, the 1970s saw the introduction of numerous Governmental agencies such as the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA), whose regulations added increased for industries.

All these factors have greatly discouraged capital investment in our basic industries in terms of expansion of existing plants and/or the building of new ones. What has been happening to U.S. industry since the early 1970s according to Akio Morita, Chairman of the Sony Corporation, is:

American companies have either shifted output to low wage countries or come to buy parts and assembled products from countries like Japan that can make quality products at low prices. The result is the hollowing of American industry. The US is abandoning its status as an industrial power (35:323).

A strong U.S. industrial base, in addition to providing the capability to support mobilization efforts, serves as a deterrence to other nations. If Mr. Morita's perception of America's industrial base is shared by the rest of the world we are in grave danger of losing a powerful deterrent factor.

The United States in the past has depended heavily on technology to maintain superiority in international competition. U.S. research and development (R&D) firms have not been given the necessary funds to maintain the lead they once enjoyed. As one author noted:

United States research and development spending as a percent of gross national product (GNP) for civilian related applications in the last decade has only been two-thirds that of Japan and West Germany. Spending on basic research has declined by 25% since the late 1960s. More important, R&D spending does no good if the results of the R&D sit on the shelf and are not incorporated into manufacturing processes and products through capital investment. Since R&D is a long process and pay-offs do not occur until well in the future, the prospects of U.S. manufacturing industries look even worse (42:94).

The era of technological research for the sake of research is gone. It is now essential to be able to translate the research into innovation. "What distinguishes industrial

economies today is not who first develops the technology but who uses it first effectively" (42:94).

America's fading leadership in the area of defense technology is often blamed on two elements. The first is the lack of Government funding for innovative research projects, and the second contributing element is the short-term profit mentality that plagues American industry (58:21). General Robert T. Marsh USAF (Retired) in a testimony before Congress on 30 March 1988, stated: "The defense industry suffers from insufficient capital investment, resulting in excessive touch labor and hence less than desired quality and productivity " (58:15).

One area of concern about incorporating technology into weapon systems is the lead time required to produce the item and get it into the field. Table 31 shows various estimated lead times for required for typical aerospace components.

The Defense Science Board issued a report in 1981 that stated that between 1977 and 1980, lead times for a variety of weapons systems and components had increased at alarming rates. Examples provided by the report included:

1. In 1976 the lead time for forgings had been 20 weeks; by 1980 this lead time had increased to 120 weeks.
2. In 1976 the lead time for traveling wave tubes had been 35 weeks; this lead time had more than doubled (to 95 weeks) by 1980.
3. Aircraft landing gear lead times had been 52 weeks in 1977 but had increased to 120 weeks in 1980 (13:117).

Reasons given for the increased lead included:

1. Raw materials shortage (titanium sponge).
2. Inadequate capacity-large backlogs in specialty metals fabrication.
3. Small buys of electronic components.

4. Very limited sources for specialty items such as optical components, bearings, electrical connectors.
5. Increasing complexity and sophistication of parts.
6. Testing and qualification requirements (13:118).

Table 31.
Average Waiting Time For Components
(58:3)

<u>End Item</u>	<u>Component</u>	<u>Time/Months</u>
Engines	Fuel controls	24
	Gear boxes	22
	Bearings	23
	Disks	20
	Forgings	13
	Castings	9
Weapons	Actuators	25
	Radomes	21
	Traveling wave tubes	20
	Servos	18
	Warhead	14
	Castings	7
	Bearings	7
Aircraft	Aux. power units	27
	Radar	27
	Avionics	24
	Landing Gear	23
	Wheels & Brakes	21
	Wings	27

There were other contributing factors to the problem of increased lead times. First, the Defense Science Board determined the Defense Priority System (DPS) was not functioning as designed. Title I of the Defense Production Act of 1950 which provides the President with authority to require that contracts he considers vital to national defense take precedence over any other contract. The purpose for the DPS

is to keep defense production on track by using a rating system for all defense orders (13).

The DPS consist of two ratings, DO, and DX. The DO rating is usually applied to all defense orders and takes precedence over unrated orders. The DX rating overrides DO ratings and is reserved for orders which impact urgent national programs. Additionally, the use of the DX rating must be approved by the President (13:108-9).

The Defense Science Board found during its investigation that the DO rating was only being given priority about 50 percent of the time. Failure of the DPS occurred as the defense orders passed from primary contractor to the subcontractors and then on to vendors. The DO rating was not being passed along with the orders. The reason cited for the mistake was that the system was not completely understood by either the Government or the contracting personnel (13:108-9).

Another factor sharing responsibility for the increased lead times was the lack of skilled personnel (such as electronics technicians, and tool and die makers) in addition to a shortage of scientists and engineers.

Yet, another factor surfaced during the early 1980s which primarily effected the electronic industry's lead times as well as the nation's vulnerability: foreign dependence. In the early 1980s it was estimated that 80 to 90 percent of military semiconductors were being assembled and tested offshore, primarily in the Far East (13).

Comparing some of the items which experienced increased lead times from 1977 to 1980 with their current (1989) lead times it becomes apparent we have yet to solve the problem of increased lead time. The lead time for traveling wave tubes increased to 95 weeks in 1980; current lead time for traveling wave tubes is 200 weeks. The lead time for aircraft landing gear rose to 120 weeks in 1980; while the current lead time for aircraft landing gear has declined, it still is 112 weeks.

The result of long lead times translates into reduced readiness and lowered sustainability of our military forces. How much of an asset is a defense industrial base which cannot produce the materials and supplies of war when they are needed? If the U.S. is to maintain any credible state of preparedness, the reduction of lead times is essential.

Donald R. Fowler and Rita A. Friga proposed a plan for reducing lead times in an article which appeared in *National Defense*. The ideas of the plan included:

1. The reason for defense industry is warfighter support, but the laws, policies, and procedures for acquisition are based on and meant for peacetime with no allowance for lead time reduction during crisis of war.
2. The acquisition process itself has become infinitely more important than the manufacturing and repair processes which result in products coming off the factory floor.
Regulatory compliance paperwork adds time and commensurate cost.
3. Political considerations and perceived needs of budget controllers force program stretchouts and uneconomic lot buys which greatly lengthen leadtimes, diminishing war-fighter support.
4. Productivity and technology enhancing measures implemented in peacetime result in lead time reduction and enhance rapid industrial resupply of warfighters

5. Having one onshore supplier capable of making each militarily critical system, item, and component is perhaps the best hedge for time. This is not protectionistic, but rather pragmatic an a capability we must allow for.
6. . . . Leadtime is the essence of the problem, the real problem in our North American Industrial Base. . . (26:28-30).

The Government has begun steps to try to correct the problems which have caused the erosion of the defense industrial base. Actions taken have primarily occurred within the framework of existing measures designed to support and regulate the defense industrial base such as the Defense Production Act of 1950 and its amendments; and government sponsored programs designed to help industries modernize.

Dr. Robert B. Costello , Under Secretary of Defense (Aquisition), stated in a 1988 report concerning the defense industrial base:

. . . First, there are broad areas of agreement among policy analysts for the need to develop rational and effective linkages among the practices, regulations, and laws that together define the environment in which our industries operate. . . Second, the Department of Defense must develop a strategy to improve the capabilities of the defense industrial base. . . (59:11).

The report, concerning the competitiveness of the defense industrial base, examined six issues:

1. the relationship between government and industry;
2. the acquisition system;
3. defense industrial plans in relation to military strategic plans;
4. developmant of concurrent manufacturing capabilities with the development of weapon systems;
5. development of the technical skills base required for tomorrow's defense needs; and
6. ensuring that industrial issues important to our defense benefit from the full spectrum of potential policy remedies, when appropriate (59).

Most of the issues examined have not cropped up overnight, but are problems which have been present within the system for some time. An example is the relationship between Government and the defense industry. The relationship has been so strained that during the 1980s the number of manufacturers willing to do business with DOD has greatly diminished. In 1982 there were more than 180,000 companies under contract to provide DOD with manufactured goods, yet by 1987 the number was less than 40,000.

While all of the losses of cannot be attributed to the adversarial relationship which has developed between government and the defense industry, it is responsible for many of them according to one author:

Some that left went out of business altogether, including about 20,000 small companies. But most companies have simply quit doing business with DOD and have opted for more reasonable customers. This is remarkable, because at the same time the defense procurement budget grew from \$54.9 billion to \$87 billion in constant fiscal 1989 dollars (8:48-9).

A report by the Washington based Center for Strategic and International Studies (CSIS) offered the following statistics:

Pentagon procurement increased every year between 1982 and 1987 by an average of 10 percent in fiscal 1989 dollars. However, the number of firms performing on those procurement dollars declined by over 67 percent during the same time (31:41).

Robert C. McCormack, Deputy Undersecretary of Defense for Industrial and International Programs, stated: "Defense contractors are leaving the ranks of subtier sources in droves due to the overregulation by the Pentagon's bureaucracy" (31:41).

The following recommendations were made in Under Secretary Costello's report for improving the relationship between Government and the defense industry:

1. Development of a Manufacturing Advisory Council, sponsored by the National Academy of Sciences, an objective third party, and;
2. A Defense Manufacturing Board, an internal organization (modeled, perhaps, after the Defense Science Board) (59).

The purpose of the establishments proposed by the Costello report is to create a structure which could provide for non-adversarial communication between industry and DOD. Work has begun within DOD to form the Defense Manufacturing Board and there has been an informal agreement by the National Academy of Sciences to create a Defense Manufacturing Strategy Committee to function in the same capacity as the proposed Manufacturing Advisory Council (59).

Another problem that has longed plagued U.S. efforts to maintain a state of preparedness is the inability to develop realistic strategic plans between the industrial base and military operational plans. A large part of the problem as it exists today is the difficulty of identifying all of the companies that are involved in the procurement process. The problem is not in identifying the prime contractors but all the little companies who act as subcontractors and vendors in the process. No one can answer how many of the subcontractors and vendors are sole sources for critical items. A case in point is Avtex Fibers of Front Royal, Virginia which, although it was not widely recognized, were the sole source for "aerospace-grade continuous filament rayon yarn". Rayon yarn is an

essential element for the nose cones and booster rockets of the vast majority of the U.S. space and strategic missile programs. It was not until Avtex announced it was going out of business and declaring bankruptcy, thus threatening the U.S. space program, that it was realized it was the sole source of rayon yarn. As a result, DOD invested \$22.6 million and NASA another \$18 million to keep Avtex open long enough to buildup a stockpile of rayon fiber and qualify another source (31:40-6).

The Costello report offered the following recommendations for matching strategic industrial planning with military operational planning:

1. The DOD should immediately establish a task force under the direction of Defense (Acquisition), staffed with specialists from the Office of the Secretary of Defense, the Military Departments, and the Organization of the Joint Chiefs of Staff, to expedite implementation throughout the Department of these and other actions identified in this report. Among other things the task force should:
2. Develop and staff a Departmental policy statement regarding strategic planning in support of military operational plans.
3. Determine the organizational structure, staffing and budget necessary to institutionalize the defense industrial strategic planning function in support of military operational plans.
4. Establish senior level liaison with selected allies, American industry, and appropriate civil agencies such as the Departments of Treasury, State and Commerce (59).

Lack of skilled people has been a problem in the past when the U.S. has mobilized the industrial base. In this era of high technology the importance of skilled personnel to industrial mobilization goes without saying. The Costello report concluded:

The Department of Defense, perhaps more than any other agency, depends on technology as its lifeblood. The

Department has a direct stake in the quantity and quality of science and engineering graduates. Efforts must be made to reverse the decline in numbers and capabilities of technically educated personnel (59).

The report made the following recommendations with regards to education:

1. The Department of Defense could provide seed money for an instrumented factory program for industries where there are large numbers of companies and significant non-defense applications.
2. The Department of Defense should combine a scholarship program in manufacturing engineering with a plan to build university expertise in manufacturing. The program should be developed jointly with industry (59).

While a strong U.S. industrial base is the focal point of the country's ability to mobilize, industrial mobilization in time of national emergency is of little use if the capability to deliver the war materials does not exist. The United States possessed the largest merchant fleet in the world at the conclusion of World War II. In 1947 the U.S. had 2,332 sea-going merchant ships available. That number has greatly declined over the years (See Figure 3), leaving just 369 active ships as of 1987. The President's Commission on the Merchant Marine and Defense reported the U.S. needs an oceangoing fleet of 850 modern ships to meet current commitments.

Taking into account the estimated 118 ships of the Navy's Military Sealift Command (MSC) and the ships of the commercial merchant marine the U.S. has a current shortfall of about 120 ships. Furthermore, the Commission reported if current trends continue the number of U.S. ships will decline to 350 by the year 2000 (15).

Number of Ships

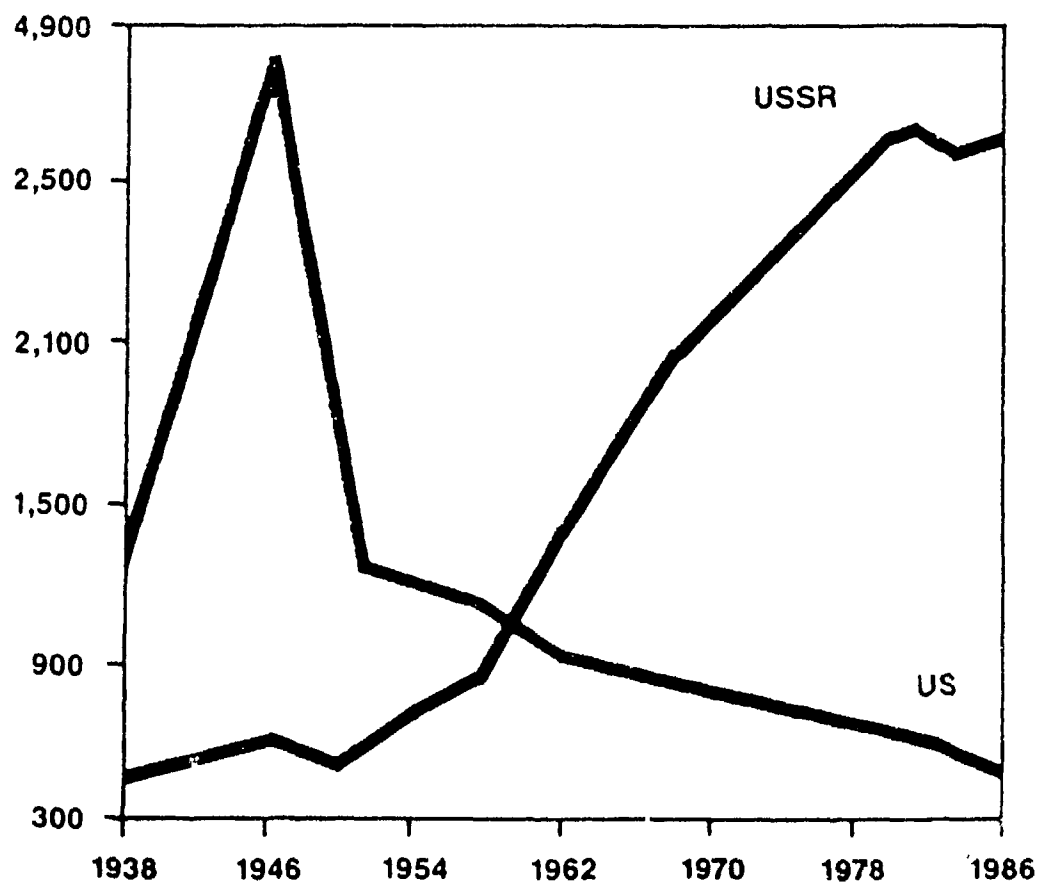


Figure 3. The Merchant Fleet (18:41)

U.S. sealift capabilities are not sufficient even when combined with the approximately 400 allied ships which are projected to be assigned to trans-Atlantic duty in the event of war. Studies conducted on sealift requirements in case of war have estimated requirements for up to 2,300 ships in a major war. It is a matter of simple arithmetic to realize that 400 allied ships plus an estimated 530 U.S. ships do not add up to 2,300 ships. It is left to the planners to sort out how to compensate for the shortfall. The topic of U.S. sealift capability is especially relevant with the on-going talks about reduction of conventional forces in Europe. The reduction of an estimated 30,000 U.S. troops from Europe will serve to put additional strain on the nation's sealift capabilities if there should be a war in Europe.

The decline of the U.S. merchant fleet has been shared by the shipbuilding industry as well. Once the world's largest shipbuilding industry, the U.S. saw the number of shipyards drop from 110 in 1982 to 89 in 1988. An inherent problem, just as it is in any industry which is in decline, is the loss of jobs and that translates into loss of experience and skills. In a ten year period, from January 1978 to January 1988, 45,000 jobs directly related to the shipbuilding industry were lost and this number does not account for those jobs lost in related areas (58:44).

The ability to man the merchant fleet is another area of concern. The current force of 29,000 merchant mariners contains many who are over fifty years old. It has been

estimated that in the event of mobilization, there would be a shortfall of at least 2,000 seamen (58:45).

The President's Commission on Merchant Marine and Defense in its 30 September 1968 report recommended six courses of action to revitalize the U.S. merchant fleet. They were:

1. Promulgate a National Policy Statement that reaffirms the Maritime Policy contained in the Merchant Marine Acts of 1920 and 1936.
2. Revitalize the United States Flag Merchant Marine in the foreign trade.
3. Implement a National Program for Merchant Ship Construction in United States shipyards.
4. Ensure greater access to international trade and cargo through trade promotion and reservation of U.S. government cargo.
5. Ensure preservation, enforcement, and strengthening of the current cabotage laws.
6. Change major Department of Defense and Department of the Navy regulations, policies, and practices.
7. Initiate and spearhead a public-private effort to improve business efficiency in the maritime industries (15:53-72).

The Commission estimated the implementation of its plan would produce:

1. 181 militarily useful ships, as well as 200 ships not militarily useful but suitable for economic support;
2. 8,570 billets on oceangoing merchant ships, providing jobs for 13,140 merchant seamen;
3. An annual average of 37,110 production workers constructing and repairing merchant ships in United States shipyards;
4. An increase in Gross National Product of over \$81 billion during the 11 year period; and
5. Total gross costs to the federal government of \$18,765 million during the 11 year period, offset by total federal government revenues of \$13,318 million (15:73).

The importance of transportation to mobilization has been seen in every mobilization since World War I. The United States cannot mobilize without a strong transportation system.

Conclusions

The industrial base became an important part of modern warfare in World War I and its importance has increased with each war. The industrial base of the United States once known as the "Arsenal of Democracy" has shown evidence of decline since the early 1970s and many people question the capability of the current industrial base to support a national emergency.

Many of the lessons of past U.S. industrial mobilizations have gone unlearned. An example is the National Stockpile. The importance of critical materials industrial mobilization has been clearly demonstrated in every war since World War I. Yet, the current National Stockpile has severe shortages of critical materials and is not up-to-date. Another example is the importance of machine tools during industrial mobilization. The shortage of machine tools was a major bottleneck in both World War II and the Korean War, yet our machine tool industry has experienced a virtual collapse.

Not only does it appear that the U.S. has failed to solve many of the problems of past industrial mobilizations, but there are new problems to compound the issue as well. Foreign competition and foreign dependence are largely responsible for the condition of the current U.S. industrial base. The U.S. has seen its industrial base erode due to its inability, for whatever reasons, to compete with foreign industry and, as a result, the U.S. is becoming a service based economy as opposed to an industrial based one. How the change will affect the ability of the U.S. to maintain a credible defense is unknown.

III. Findings and Analysis

Introduction

This chapter presents and discusses the findings of this research. A two step approach was used in carrying out the research. First, an extensive literature review of the United States' industrial mobilization experiences from 1916 to 1988 was conducted. The literature review served a two-fold purpose: it provided the researcher a solid knowledge base of the topic, and it provided ideas which used in the second step of the research. The second step involved conducting a Delphi survey of 10 individuals with extensive experience and knowledge of U.S. industrial mobilization. The Delphi survey was used to evaluate various facets of U.S. industrial mobilization, including estimating the capability of the current industrial base to mobilize.

Delphi Survey

The survey (See Appendix A and C) was comprised of four general topic areas: (1) the historical relevance of past U.S. industrial mobilizations to future U.S. industrial mobilization; (2) the health of the present U.S. industrial base; (3) problems with the current U.S. industrial base; and (4) respondents' views of current conditions of the U.S. industrial base. The 14 survey questions with Likert scale responses asked the respondents' degree of agreement with statements concerning elements of the industrial mobilization.

Four questions required the respondents to rank order different characteristics of industrial mobilization or the industrial base. One multiple choice question was included which asked the respondents to make a determination regarding one characteristic of the current industrial base. Additional comments were solicited after each question, at the end of each section, and at the end of the survey.

Round One Results. Only seven of the ten individuals agreeing to participate responded to the first round of the survey. A consensus of 70 percent or more was attained on 12 of the 14 Likert scale responses and on the multiple choice question. The questions which received a consensus response during the first round were not repeated in the second round of the survey. The Likert scale responses of round one are shown in Table 32. Frequencies for the four rank order questions were examined to determine if a consensus was attained. Table 33 shows the responses to the rank order questions of round one of the survey.

Topic 1: Historical Relevance. The respondents did not reach a consensus on the questions concerning the current validity of past experiences of U.S. industrial mobilization. Question 1a asked the respondents if they thought past industrial mobilization experience remains valid for future preparedness planning. Four of the respondents agreed the experience gained from past industrial mobilization efforts remains valid, while three disagreed. Comments made by the respondents (See Appendix B) strongly supported both views.

The comments made by the respondents concerning the historical relevance of industrial mobilization tended fell in to two categories: statements supporting the short war scenario, hence negating the importance of industrial mobilization, and statements supporting the idea of past industrial experience remaining valid.

A consensus was not attained during round one on the question 1b which asked the respondents to rank order the past U.S. industrial mobilization they thought provided the most significance for future industrial preparedness planning. The range of responses included each of the possible choices as the number one selection. The possible choices were: World War I, World War II, Korea, Vietnam, and No Help. The question was included in the second round of the survey.

Topic 2: The Health of the Present Industrial Base. The respondents reached a consensus on question 2a regarding the capability of the current industrial base to provide adequate support if mobilized. The consensus was the current industrial base is not capable of providing the type of support required during mobilization. Comments made by the respondents pointed to U.S. foreign dependence for strategic materials and weapon components as being largely responsible for the inadequacy of the industrial base to support mobilization.

A consensus of opinion was attained on question 2b which asked the respondents whether industrial preparedness planning should focus on a short war or a long war scenario. The

Table 32.
Likert Responses -- Round One Delphi Survey

Topic	Question	Ratings					Mean	Consensus
		1	2	3	4	5		
1	a.	0	4	0	3	0	2.85	No
2	a.	0	1	0	3	3	4.42	86% don't agree
	b.	0	1	0	6	0	4.33	86% don't agree
	e.	8	0	0	1	0	1.42	86% agree
	g.	0	0	5	2	0	3.28	71% neither
	h.	0	0	2	5	0	3.71	71% don't agree
	i.	0	2	2	3	0	3.14	No
	j.	0	1	0	4	2	4.00	86% don't agree
	k.	0	0	1	6	0	3.85	86% don't agree
	l.	0	0	1	5	1	4.00	86% don't agree
	m.	0	0	1	6	0	3.85	86% don't agree
	n.	0	1	1	5	0	3.57	71% don't agree
	o.	0	0	1	1	5	4.57	86% don't agree
	p.	0	0	2	5	0	3.71	71% don't agree

consensus was industrial preparedness planning should not focus on the short war scenario. One respondent commented:

I think too many people focus on the short war: 'we go nuclear and it's all over'. I think a some what 'long' conventional war is more likely than an immediate holocaust.

Question 2c asked the respondents to choose who should be responsible for deciding industrial preparedness planning. The respondents reached a consensus with 71 percent selecting the choice which specified joint committee membership with government and industry being represented. The comment made by one respondent reflected the following view:

I believe industrial preparedness needs to be a focus point at the highest levels of government and industry. It's more than a defense issue perse it also deals with our future as an industrial lead nation.

The respondents did not reach a consensus on question 2d which ask them to rank order a list of items and the impact they have on current industrial base capabilities. The range of responses included the following as having the most impact on current industrial base capabilities: Defense budget; Dependence on foreign sources; Raw material availability; and Skilled workers. The question was included in round two of the survey.

A strong consensus was reached on question 2e which asked the respondents whether more empahasis needed to be placed on industrial preparedness. Six of seven of the respondents either agreed or highly agreed that more emphasis was needed. One respondent stated, "Our role as a world leader depends on it".

Question 2f asked the respondents to rank order a list of agencies involved with industrial preparedness as to which agency needed to place more emphasis on industrial preparedness. The top responses included: President's cabinet, DOD, the Congress, Industry, and the Military services. The question was included in the second round of the survey.

The only question in the survey with the respondents reached a consensus in which they neither agreed nor disagreed was question 2g. This question asked whether the military services were doing an adequate job of industrial mobilization planning. Comments from the respondents indicated they did not possess enough knowledge of current procedures within the military services, with regards to industrial mobilization planning, to agree or disagree with the question.

A consensus was reached on question 2h which asked the respondents if the military services were doing an adequate job with industry with regards to industrial preparedness. Five out seven respondents disagreed that the services were doing an adequate job of preparedness planning with industry. One respondent commented:

As I said before, the military tries but there is too much emphasis on the short range profit rather than the long term. The bottom line for industry is strongly impacted by the tax laws.

Question 2i asked the respondents if the defense budget should constitute a larger portion of the GNP. The responses were divided with two respondents in agreement, two respondents neither in agreement nor disagreement, and three respondents in

disagreement. The question was included in the second round of the survey.

Question 2j was another question which attained a strong consensus with six of seven respondents either disagreeing or highly disagreeing. The question asked the respondents if the current relationship between industry and government promoted industrial preparedness planning. According to the results of the survey the current relationship between government and industry does not foster industrial preparedness planning. One respondent wrote, "No incentive for either side. No budget, impossible acquisition process - therefore, no incentive."

The respondents reached a consensus on question 2k with six of seven respondents disagreeing or highly disagreeing with the statement that a sound industrial base currently exists for U.S. industrial mobilization. One respondent simply commented, "Our industrial base is declining." While other respondents chose to expand their views, they agreed with the previous comment.

Question 2l likewise received a strong response from the respondents with 86 percent of them disagreeing with the statement that a sound industrial base currently exists for United States industrial preparedness.

Question 2m asked the respondents if DOD is doing an adequate job with civilian industry to assure a sound defense industrial base exists in the United States. The respondents attained a consensus with 86 percent disagreeing that the DOD

is doing an adequate job with industry with regards to assuring a sound defense industrial base exists. One respondent commented, "I think Defense should work more with Congress to foster greater industry cooperation but my view is that Congress has a different agenda."

Question 2n asked the respondents to respond to the statement that an adequate review of industrial preparedness is conducted by the DOD. A consensus was attained with 71 percent of the respondents disagreeing with the statement.

The respondents reached an 86 percent consensus on question 2o, which asked the respondents if the U.S. currently has an adequate industrial mobilization plan. Five out of the seven respondents responded that the U.S. currently lacks an adequate industrial mobilization plan.

Question 2p asked the respondents if the U.S. currently has an adequate controlling structure in place for industrial mobilization. A consensus of 71 percent was reached with five out the seven respondents disagreeing that an adequate controlling structure currently exists for industrial mobilization.

Topic 3: Problems with the Current Industrial Base.

Question 3a asked the respondents to rank order a list of items as to which represented the biggest challenge to the current industrial base. The top responses included: Public opinion, Government support, and foreign competition. A consensus was not reached during round one of the survey and, as a result, the question was included in round two.

Table 33.
Rank Order Responses -- Round One Delphi Survey

<u>Topic</u>	<u>Question</u>	<u>Items</u>	<u>Rank</u>	<u>Frequency</u>	<u>Consensus</u>
1	b	World War II	1	3	NO
		Vietnam	1	3	
		No significance	2	2	
		Korea	2	2	
		World War I	3	1	
2	d	Defense Budget	1	2	NO
		Foreign Dependence	1	2	
		Raw Materials	1	2	
		Skilled Workers	2	3	
		Others	3	2	
	f	President's Cabinet	1	3	NO
		Congress	2	2	
		DOD	2	2	
		Industry	3	4	
		Services	4	3	
	g	Public Perception	1	3	NO
		Government Support	2	4	
		Foreign Competiton	3	3	
		Number of Skilled workers	3	3	
		Education of Work-force	4	3	
		R&D	5	2	

Question 3b was the only multiple choice question in the survey. The respondents were asked the following question. "Recent research suggests that it would take approximately 18 months for many facilities to double production rates. Do you see this as a problem?" Six out the seven respondents were in agreement that it would cause problems. See Appendix B for comments of the respondents.

Topic 4: Respondents' View of Current Conditions of the Defense Industrial Base. Question 4a was an open ended question which asked the respondents to comment on any aspect of industrial mobilization they desired. Comments made by the respondents covered a wide range of topics and indicate that many of them believe there are serious problems with the current defense industrial base. See Appendix B.

Round Two Results. Questions on which a consensus was not reached were resubmitted in round two along with comments made by respondents during round one of the survey. Although consensus questions from round one were not repeated in round two, the consensus responses were provided to the respondents.

Only seven out the ten participants responded to the second round of the Delphi survey. The seven respondents to the second round were the same individuals who responded to the first round. Several attempts were made to contact the three individuals who did not respond to the survey but the efforts proved unsuccessful.

The respondents' answers during the second round tended to emphasize their first round responses. As a result, only two of the five questions included in round two of the survey resulted in consensus. Although definite reasons why all of the questions did not result in a consensus are not known, a contributing factor may have been the types of questions. The questions which resulted in a consensus were Likert scale questions, whereas the three questions which did not reach a consensus were rank order type questions. While

the answers were much the same during the second round of the survey, the respondents did make additional comments on various topics concerning U.S. industrial mobilization. See Appendix D for the second round comments.

Topic 1: Historical Relevance. Table 34 shows the round two response to the Likert scale question. The question regarding the current validity of past U.S. industrial mobilizations was resolved as six out of seven respondents agreed that past industrial mobilization experiences remain valid. Two respondents changed their first round responses from disagreeing to agreeing in the second round.

While the respondents agreed that past industrial mobilization experiences remain valid, they did not agree on the ranking of the significance of past industrial mobilization experiences (See Table 35). The respondents' answers were much the same as they were in round one with only one of the respondents changing their first round response during round two of the survey.

Topic 2: The Health of the Present Industrial Base. Question 2a asked the respondents to rank order a list of items as to their impact on the current industrial base capabilities. Although there was not a clear consensus attained by the respondents as to the impact of the factors on the current industrial base (See Table 35), there was a change in the rank order sequence from the first round responses. The change occurring in round two can be attributed to the three respondents who chose to change their first round responses.

The Defense Budget was the top response in round one while the top response in round two was Foreign Dependence.

Question 2f asked the respondents to rank order a list of agencies as to which need to place more emphasis on industrial preparedness. Again, although a consensus was not reached on this question during round two (See Table 35), there was a change as two of the seven respondents revised their first round responses. The top response in round one was the President's cabinet while the top response in round two was Congress.

Question 2i stated the defense budget should be a larger portion of the GNP and asked the respondents if they agreed or disagreed with the statement. A consensus was reached with 71 percent of the respondents disagreeing the defense budget needs to be a larger portion of the GNP. One respondent commented:

More money thrown at the same general policies with instructions to 'think industrial preparedness' will become a big boondoggle and not solve the major issue. It must be in a contractor's best economic interest to structure production processes, maintenance of 2nd tier suppliers, etc. towards industrial preparedness - not towards minimum production cost for his best guess of a government production run on weapon 'Z'.

Table 34.
Likert Responses -- Round Two Delphi Survey

Topic	Question	Ratings					Mean	Consensus
		1	2	3	4	5		
1	a	0	6	0	1	0	2.2	86% agree
2	i	0	2	0	5	0	3.42	71% don't agree

Table 35.
Rank Order Responses -- Round Two Delphi Survey

<u>Topic</u>	<u>Question</u>	<u>Items</u>	<u>Rank</u>	<u>Frequency</u>	<u>Consensus</u>
1	b	World War II	1	4	NO
		Vietnam	2	3	
		No significance	3	2	
		Korea	3	2	
		World War I	4	1	
2	d	Foreign Dependence	1	3	NO
		Defense Budget	1	3	
		Raw Materials	2	2	
		Skilled Workers	2	2	
		Other	3	1	
	e	Congress	1	4	NO
		President's Cabinet	2	3	
		DOD	2	3	
		Industry	3	2	
		Military Services	2	1	

Summary

This chapter described the results of the two step methodology used in this research. The knowledge gained from the literature review along with recommendations of Mr. Jerry Peppers was used to construct a Delphi survey. The resulting survey was useful in attaining the perception of individuals who have vast knowledge of U.S. industrial mobilization. The participants selected for the survey came from the military and industry, with some of them having retired from the military and being currently employed by industry.

The next chapter answers the research objectives and questions. Issues raised by those answers are addressed and recommendations for further research are presented.

IV. Conclusions and Recommendations

Introduction

The ability of the U.S. industrial base to mobilize in the event of war is impacted by many factors such as public opinion, availability of raw materials, capital investment, availability of labor, availability of transportation, and foreign supply sources, to name but a few. It is this myriad of elements affecting the industrial base which in part makes it difficult to accurately assess its current capabilities to respond to a national crisis. However, no matter how complex the task every effort should be made to achieve an accurate assessment of the industrial base and its ability to mobilize because as Solon so warned Croesus, "Sir, if any man hath better iron than you, he will be the master of all this gold" (42:90).

Answers to the Investigative Questions

This research was centered around a number of questions which were posed at the beginning of this study. Analyzing the answers to the questions will provide an evaluation of the current industrial base with respect to this research.

Question One. What were the lessons learned from previous industrial mobilizations, and were they being considered in current industrial mobilization planning?

Answer. This research traced the history of U.S. industrial mobilization from 1918 to 1988 to establish a sense of what worked successfully and what did not work during past industrial mobilizations. The lessons learned from each war since World War I, while being unique, still have similarities.

Perhaps the most striking similarity between the wars is the failure of the United States in each to be prepared to wage war. While the state of unpreparedness could have proved devastating, it did not. The primary reason why the U.S. was able to recover from being unprepared for war is that in past wars the U.S. has had the benefit of two key allies: time, and distance. These allowed our industrial base to gear up to meet the challenges of war. However, in this era of high technology weapons such as Inter-Continental-Ballistic-Missiles (ICBMs), and nuclear submarines, there is no guarantee we will be afforded the luxury of time and distance in future conflicts.

Since World War I and the introduction of mechanization for combat, the need for civilian industry to support the demands of modern warfare has increased dramatically. However, we entered each successive war with an industrial base which was ill-prepared at the time to support combat operations. An example of this failure is the shortage of munitions which has plagued the war efforts of the U.S. since World War I. Both political and military leaders have in past preparations for war have chosen in many instances to ignore the lessons learned from prior wars and, as a result, in effect chose to repeat costly mistakes. The failure to maintain an adequate munitions

base during peacetime is but one such mistake. The same case can be made for any number of issues. The U.S. machine tool industry, whose importance to industrial mobilization is well documented, represents such an issue. Although actions have now been taken by U.S. leadership to try to stop the nose-dive of this essential industry, those actions took three years following determination that the state of the industry impaired national security. The Strategic Stockpile is another current issue whose importance to past industrial mobilizations has been proven, yet our current stockpile has billions of dollars in shortages of critical materials and is not even up-to-date in decision as to what materials should be stockpiled.

Another lesson learned from our past industrial mobilization efforts was the need for a central controlling governmental function. However, it was not until the Korean War and establishment of the Office of Defense Mobilization (ODM) that we acted so as to not repeat the trial and error approach to establishing mobilization control. The current controlling structure for mobilization is confusing to say the least. The Federal Emergency Management Agency (FEMA), along with the Department of Commerce and the Department of Defense is the primary agency but all three share responsibility for assuring the mobilization base is prepared to meet future challenges. While those agencies share the primary responsibility for mobilization, there are numerous other government agencies which also are involved in some aspect of the process. Therein lies much of the confusion. In addition,

there is question as to the "clout" of FEMA in the political structure. The current policy has FEMA serving in an "advisory" capacity to the National Security Council (NSC). World War II, with its trial and error approach to mobilization, went through a series of mobilization controlling structures because they could only act in an "advisory" capacity and lacked the authority to control mobilization.

Another lesson learned from past industrial mobilizations is that, given time, the industrial base given is capable of producing the necessary combat equipment and supplies to meet the demands of war. However, as was discussed earlier, there is no assurance the next conflict will allow us the time required to expand the industrial base. Additionally, the industrial base of the U.S. no longer is the dominating manufacturing force it was after World War II. The shift of the United States from an industrial based economy to a service based economy is well documented. However, what is unknown, although there is much speculation, is how this shift will effect the ability of the U.S. to mobilize and supply its forces in time of war. While there is not much "hard" evidence of the effect the shift will have on mobilization, common sense should prevail in the fact that we cannot mobilize what we no longer have.

Question Two. What were the effects of more complex weaponry, due to technology, on the ability of the industrial base to respond if mobilized?

Answer. There is little doubt that the advent of technologically superior weaponry has caused the industrial base to increase manufacturing lead times. However, as the 1981 study on weapon lead times conducted by the Defense Science Board indicated, increased lead times could not be solely attributed to the technology involved. The findings of the Board showed there were many contributing factors, in addition to technology, which contribute to the increased lead times such as raw material shortages, limited sources for certain items, and inadequate plant capacity.

One effect of the increased technology of modern weaponry is the greater need for skilled labor. The shortage of skilled people, technicians as well as engineers and scientists, could hamper the ability of the industrial base to mobilize. The problem of skilled labor is one which has continued to haunt U.S. preparedness for some time. The U.S. experienced shortages of skilled personnel during past mobilizations and there is a strong possibility shortages would again be experienced if the current industrial base was mobilized.

Another aspect of advanced weaponry which needs to be addressed is the effect off-shore production has on the ability of the industrial base to respond in a timely manner. Since the early 1980s there has been a growing trend, especially true in the electronics industry, for U.S. companies involved in defense production to rely on off-shore manufacturers. The reason for this trend is simple economics.

U.S. companies in many instances can buy items manufactured off-shore cheaper than they can produce them at home. While using off-shore manufacturers might make good business sense, one cannot help but question the impact on the ability of the industrial base to mobilize. The possibility of being cut-off from off-shore sources during time of war is very high and the impact of that happening must be considered in our preparedness planning.

One possible solution to the dilemma is ensuring there is at least one manufacturer in the United States capable of producing any critical component which currently being produced off-shore. In addition to identifying domestic sources for production, there needs to be a stockpile of critical items which are now being supplied by off-shore manufacturers. This stockpile would, in the event we were cut-off from off-shore sources, serve to fill demand until our domestic sources could get up to speed.

As was discussed in the research, a serious problem we are currently encountering is attempting to identify sole source suppliers of critical components. The reason for the difficulty is that in many cases the sole source is so far down the procurement labyrinth it is not tracked.

Question Three. What were the critical resources (raw materials, manpower, etc.) needed to support industrial mobilization; was there an adequate supply of each; and have they been stockpiled?

Answer. The industrial base is obviously dependent on resources. Without them industries cease to function. A simple statement but quite accurate and exceptionally important. World War I and the beginning of mechanized war served to thrust the importance of the industrial base to the forefront of modern warfare. With the increased importance of the industrial base came the increased importance of critical resources to support the it.

The U.S. industrial base experienced shortages of a number of critical resources during World War I. Some of the shortages included coal, tungsten, nitrogen, aluminum, and chrome. The reasons for the shortages were many and ranged from the inability of the government to establish adequate controls on certain resources, such as coal, to the inability of a producer to keep pace with the demands of war, such as the case with aluminum, to the dependence on foreign sources for resources, as was the case with tungsten. World War I brought attention to the fact that resources for which we rely on foreign sources should be stockpiled. While there was a stockpile of sorts established in World War I, it was not sufficient to meet the needs of another war.

Another resource shortage experienced by U.S. industry during World War I which impacted mobilization was the shortage of manpower. There were two primary reasons for the shortage of labor. First, manufacturing tended to be centered in the NorthEastern portion of the country. The industrial base during the war also expanded in the same area, which resulted

in the NorthEastern section of the country becoming saturat with key industries. Not enough people were available in the geographical location to support the need for labor. The second cause of the labor shortage was the draft. As men were called to serve in the military vacancies occurred leaving industries short of workers.

The labor shortages eased as people migrated to the NorthEast, primarily from the South, to find work. In addition, many non-traditional sources of labor, such as women and blacks, were employed by industry during the war, which helped with the labor shortages.

During World War II U.S. industry again experienced shortages of critical resources and manpower. While the reasons for the shortages affecting industry were not all the same as in World War I, the results were the same. The shortage of skilled people hampered the ability of the industrial base to mobilize.

Shortages experienced by industry during World War II included rubber, copper, aluminum, and machine tools. The reasons for many of the shortages in World War II parallel the reasons in World War I. At the start of World War II the U.S. was for all intents and purposes dependent on foreign sources for rubber. Concern about the possibility of the U.S. being drawn into the war, as well as concern about critical materials for which the country was dependent on foreign sources, prompted Congress to pass the Strategic Materials Act of 1939. The legislation set the legal base for the establishment of a

strategic materials stockpile. However, stockage got off to a very slow start and the stockpile was not as effective as it might have been. As a result of an inadequate stockpile the U.S. was forced to use ingenuity and substitute materials to solve some of its shortages during World War II. The creation of the synthetic rubber industry was the result of such ingenuity. But, again, time was a problem and our salvation. We may not again have time to accomplish those kinds of feats.

Another resource shortage which impacted industry's ability to mobilize during World War II was the lack of machine tools. The shortage of machine tools can be largely attributed to the rate with which industry expanded once the U.S. entered the war. Another contributing factor to the shortage of machine tools was that in many instances the new weaponry of World War II required machine tools which did not exist before the war. The U.S. machine tool industry experienced tremendous growth during World War II. However, those gains during the war were more than off-set by the rapid and uncontrolled demobilization of the industrial base at the conclusion of the war.

U.S. industry experienced labor shortages during World War II just as it had in World War I. The reasons for the shortages were not the same. The United States was still recovering from the effects of the Great Depression when the buildup for World War II began. Unemployment rates were high during the depression with millions of Americans from every walk of life out of work. Along with the high rates of

employment went the loss of acquired skills as people searched for work of any kind just to survive. The result was a void of skilled workers as we began preparing for war. Government teamed with industry and instituted a wide range of training programs across the country to retrain American labor - including minorities and women.

The draft had a much larger effect on industry during World War II than it had during World War I because being the scale of the conflict was greater and the duration much longer. More than 17 million were drawn into military service in the almost four year war. As a result, women and minorities once again played a key role in the mobilization of U.S. industry and they made great contributions to the war effort.

U.S. industry did not experience shortages of resources during the Korean War to same degree. One reason was the limited scope of the war. Another reason was that U.S. leadership established a mobilization policy which would allow for a gradual buildup of the industrial base and at the same time support an increased standard of living for Americans.

One shortage which did adversely impact the industrial base during the Korean War, especially during the early stages, was machine tools. The rapid demobilization of the industrial base after World War II came back to haunt us during the buildup for the Korean War less than five years later. The capacity of the U.S. machine tool industry in 1950 was actually less than it had been in 1942. The shortage of

machine tools resulted in extensive government support of the machine tool industry during the war.

The industrial base of the U.S. was not mobilized for the War in Vietnam as our leadership chose to fight the war by surging industry as needed to meet the periodic demands of the war. The decision not to mobilize the industrial base served to place the production of defense related materials in direct competition with the production of consumer goods. The shortages experienced during the Vietnam War were felt for the most part by our military forces rather than by industry. The primary reason for the Vietnam War shortages was the lack of priority given to the production of war items.

Question Four. What were the relationships between the National Defense Budget and the ability of the industrial base to mobilize?

Answer. The U.S. has a long history of not wanting to commit funds for preparedness during peacetime. The relationship between the National Defense Budget and the ability of the industrial base to mobilize is directly proportional. It takes adequate funding for the industrial base to mobilize. Without that funding the ability of the industrial base to mobilize is minimal, to say the least.

Historically, industrial mobilization has not been funded in times of peace. But, at the start of war, the influx of money into the war effort is staggering. The point worth

mentioning is that while it does not take long to allocate funds the same cannot be said for acquiring weapon systems.

Conclusions

It is apparent from this research that our current industrial base suffers from many of the same ills which have plagued past industrial mobilization efforts. These include the lack of skilled people, shortages of critical materials, and an inadequate machine tool industry. In addition to the problems of the past, which still impact the ability of the current industrial base to mobilize, are a number of relatively recent problems such as increased foreign dependence for critical resources and an ever shrinking industrial base. Yet, even with all of the indications that our industrial base could not support mobilization if called upon, we still have virtually the same defense commitments we had at the conclusion of World War II. As the cost of defense increases, and the capability of our industrial base decreases, it is time to realistically evaluate our capabilities as well as our commitments.

While much attention is given to the loss of American jobs due to the declining industrial base, more needs to be said about the threat to national security posed by the loss of the industrial base. Public opinion in the United States is a powerful tool, as has been proven time and time again. A national publicity campaign highlighting the condition of the industrial base along with a plan for improving its current state should be given top priority by our leadership.

Recommendations for Further Research

This research effort took a macro viewpoint of U.S. industrial mobilization. Some recommendations for further study and which represent a more micro approach to industrial mobilization are as follows:

- Conduct research into the capabilities of U.S. infrastructure to support industrial mobilization.
- Conduct research focusing on the controlling function of mobilization.
- Conduct research focusing on the preparedness planning process between industry and the military services.
- Conduct research regarding requirements determination in times of mobilization.
- Conduct research which examines the role of WRM during industrial mobilization.
- Conduct research to determine the planning for, and funding of, military industrial readiness and mobilization programs.

Appendix A: Round One Delphi Survey

Mr. John Doe
0000 AFIT Drive
Fairborn, Oh 45385

Dear Mr. Doe:

Thank you for agreeing to participate in this survey. The purpose of this research is to trace the history of U.S. industrial mobilization efforts from 1916 to 1988 and to assess the capability of the current industrial base to meet mobilization requirements if called upon. Your opinions and comments will be combined with those of other experts to help determine the present state of the industrial base.

Attached is a Delphi survey that solicits your opinions on a variety of topics concerned with industrial mobilization. To assist in timely completion of this research, please complete the survey and return it in the enclosed envelope within 7 days. The results from the first round of the Delphi survey will be compiled and a second round Delphi survey will be mailed to you.

Comments and suggestions regarding this research are encouraged. Call me at (513) 233-7379 if you have any questions concerning this survey or about the research in general. Thank you for your contribution to this project.

Michael T. England, Capt, USAF
Graduate Student
Graduate Logistics Management Program
School of Systems and Logistics

2 Atch
1. Delphi Survey
2. Return Envelope

Round One Delphi Survey

Survey Objectives:

- a. To solicit expert opinion about factors concerning the U.S. industrial base and its ability to mobilize.
- b. To determine what elements of industrial preparedness planning should be considered for an effective industrial mobilization policy.

Definitions:

- a. Industrial Mobilization: The conversion of the commercial economy to wartime production.
- b. Industrial Surge: The initial rapid acceleration of the production of war materials while maintaining commercial output. The first step of industrial mobilization.
- c. Industrial Base: Industries, both those privately and publicly owned, engaged in the production of war related materials.
- d. Industrial Preparedness: The ability of the industrial base to produce war materials in case of industrial mobilization.

General Comments:

- a. The topics covered in this survey are not meant to be complete or exhaustive in nature. The aim of the questions is to be thought provoking and to urge your comments.
- b. Honest opinions are vital to the success of this project. The answers are subjective and, as such, there are no correct or incorrect answers. Any comments or ideas you may have should be included as they may generate further comments by other participants in later rounds.
- c. The objective of the Delphi technique is to continue the survey process until a group consensus is reached. It will take at least two rounds of questioning to attain the objective. After each round, all participants' responses will be compiled and returned to you at the start of the next round. An executive summary of this project will be sent to you at the conclusion of the research.
- d. You may be assured of complete anonymity. Your name will not be used with regards to your participation or your comments.

Specific Instructions:

- a. For questions which require an answer along a scale, please circle the response which you most identify with.
- b. For questions which require a ranking response, please rank order using "1" for the most important item and continue to rank subsequent items by order of importance.
- c. In the space provided, following the questions, please write the rationale for your answers. Include any additional information you think might help the other participants to understand your response. You may use the back of the survey if you require more space. If you choose to use the back of the survey to comment on a question, please number your response so that it reflects the question to which you are responding.
- d. Please feel free to include any additional ideas or comments you may have concerning U.S. industrial mobilization. The last page of the survey is provided for other comments you think may be relevant to this project.
- e. Any questions in regards to this survey or the research project should be directed to Capt Michael England at (513) 233-7379. Once again, thank you for your participation.

Topic 1: HISTORICAL RELEVANCE

a. Experience from past industrial mobilization efforts remains valid.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

b. Which of the past industrial mobilization efforts do you think provides the most significance for future industrial preparedness planning? Please rank order your response.

_____ World War I
_____ World War II
_____ Korea
_____ Vietnam

_____ I do not think experience from past industrial mobilizations will help in preparation for future conflicts.
COMMENTS: _____

TOPIC 2: THE HEALTH OF THE PRESENT INDUSTRIAL BASE

a. The current industrial base has the capability to provide adequate support if mobilized.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	agree	highly disagree

COMMENTS: _____

b. Industrial preparedness planning should focus on a "short war" as opposed to a "long war" scenario.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

c. Who should be responsible for deciding industrial preparedness planning strategy? Please circle the number of the response you most agree with.

1. The President
2. Congress
3. A committee that includes industry and government membership
4. Other (please specify) _____

COMMENTS: _____

d. Please rank order the following items from highest (1) to lowest (4 or 5) to indicate the impact you think they have on current industrial base capabilities.

- _____ Defense budget
- _____ Dependence on foreign sources for defense related resources
- _____ Raw materials availability
- _____ Skilled workers
- _____ Other (please specify) _____

COMMENTS: _____

e. There needs to be more emphasis placed on industrial preparedness.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

f. Please rank order the following items from highest (1) to lowest (5 or 6) to indicate what agencies need more emphasis on industrial preparedness. Check the last item if applicable.

- _____The Congress
- _____The President's Cabinet
- _____The Department of Defense
- _____The Military Services
- _____Industry
- _____Other (please specify) _____
- _____I feel enough emphasis is placed on industrial preparedness

COMMENTS: _____

g. The military services are doing an adequate job of industrial mobilization planning in the United States.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

h. The military services are doing an adequate job of industrial actions with civilian industry in the United States.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

i. The Defense Budget should be a larger portion of the GNP (currently it is approximately 8%).

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

j. The relationship between government and industry is such that it promotes industrial preparedness planning.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

k. A sound industrial base currently exists for U.S. industrial mobilization.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

1. A sound industrial base currently exists for United States industrial preparedness.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

m. The Department of Defense is doing an adequate job of working with civilian industry to assure a sound defense industrial base exists in the United States.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

n. An adequate review of industrial preparedness is conducted by the Department of Defense.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

o. The United States government currently has in effect an adequate industrial mobilization plan.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

p. The United States government has in being an adequate control structure for industrial mobilization in event of war.

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

COMMENTS: _____

TOPIC 3: PROBLEMS WITH THE CURRENT U.S. INDUSTRIAL BASE

a. The biggest challenge facing today's current industrial base is: Please rank order from most important (1) to least important (6 or 7)

- _____ Government support
- _____ Public perception
- _____ Education of the work force
- _____ Foreign competition in the market place
- _____ Research and development
- _____ Number of workers in the "skilled trades"
- _____ Other (please specify)_____

COMMENTS: _____

b. Recent research suggests that it would take approximately 18 months for many facilities to double production rates. Do you see this as a problem?

1

2

Yes

No

COMMENTS: _____

TOPIC 4: YOUR VIEW OF THE CURRENT CONDITIONS

a. Please provide your comments on the topic of the defense industrial base, the existing problems as you see them, the existing cooperation between DOD and industry, industrial preparedness planning, or any other issues you feel are pertinent to the topic.

COMMENTS: _____

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

220

Appendix B: Delphi Round One Comments

Topic 1: Historical Relevance

Questions a. and b.

Our weapons come from worldwide sources and I see any future wars being of short duration.

I do not think any of our past mobilizations are specifically relevant to present mobilization requirements. However, any experience provides a knowledge base for planning. It is my belief that mobilization will have to become effective in 30 to 45 days max.

The modern "competitive" society is by far the best base of experience.

Even though I marked World War II, the period of mobilization started long before 7 December 1941 . . . and though we turned out massive amounts of hardware - we really did not reach "full production" until close to the end of the war - a war in which we were not under strategic attack - as Germany and Japan were.

My evaluation applies to "all out" conflict where national survival is at risk. For limited or conventional conflicts the Vietnam experience applies.

World War II was the most impressive buildup to me and we had many advantages then which we do not have now.

Topic 2: The Health of the Present Industrial Base

Question a.

Our industrial base is shrinking. Strategic metals are scarce and in the hands of people not supportive to us. Skilled personnel availability is also a problem.

Critical weapon system components are not available in the U.S. therefore, we have little or no control over the source.

We couldn't sustain mobilization if we wanted to.

Both 1st and 2nd tier would have trouble responding.

Question b.

We need to prepare for the long war, but we must be ready for rapid mobilization. The short wars can be won or lost with the resources we have in-hand on the first day of the war.

Rapid surge requirements don't mean doing away with long-term rate considerations.

A short war will be a "come as you are" affair.

Again, a lot of what we need we need to wage war comes from off-shore sources.

Depends upon whether you believe or disbelieve the nuclear option is viable. I personally do not believe we'll push the button and, as such, think we ought to prepare for a long haul.

I think too many people focus on the short war: "we go nuclear and it's all over". I think a somewhat "long" conventional war is more likely than an immediate holocaust.

Question c.

The Executive Branch has the responsibility, expertise, and can allocate resources to this purpose. Congress is in approval cycle through the budget process.

I believe industrial preparedness needs to be a focus point at the highest levels of government and industry. It's more than a defense issue because it also deals with our future as an industrial lead nation.

This "competitive" industry is regulated to the point that Government incentive and industry commitment are both required to change the situation.

The President is responsible for policies that determine how the country will be defended. Mobilization is a very important policy matter.

Question d.

I chose the Defense Budget as number 1 since it now leads the nation in the R&D world. This a sad statement, I know, but things are a lot different now.

Current acquisition practices, including the god of competition, procurement set asides, unreasonable oversight, and lack of adequate business have done more to erode this nation's industrial base than any other Government practice.

Lead time to acquire raw materials and process them into stocks for the manufacturing process is critical.

Government procurement and competition regulations, insufficient incentives to modernize, uneconomical order quantities, etc. lead to a generally unstable defense industry and, as such, preparedness suffers directly.

Question e.

Short wars call for having stockpiled what you need to fight.

Our role as a world leader depends on it.

Question f.

Fundamental changes in our society and government are needed.

I view the President's cabinet, DOD, and Military Services as the Executive Branch. If the President decides then they will follow.

I have no knowledge of what's going on in industrial preparedness these days. The ranking is on the basis of who should be concerned with rather than what agencies need more emphasis.

Question g.

Look at funding profiles and that tells you no one believes we'll go to war.

I'm not aware of what the services are doing.

There is no priority for industrial mobilization planning - no budget allocation - no room in weapon system acquisition - no incentive to industry.

I think they try but they're not getting enough support.

They've done more lately.

Question h.

No priority and little resource to do the job. Talk but little action.

As I said before, the military tries but there is too much emphasis on the short range profit rather than the long term. The bottom line for industry is strongly impacted by the tax laws.

I suspect this statement is true.

Absolutely not - all recent changes to the DARS and FARs serve to take away incentives from industry. Cost of money is no longer an allowable cost, break-out of production results in less investment by industry in production facilities and other resources.

Question i.

Or else let the defense industry act more like commercial businesses i.e., reduce paperwork, surveillance, catchy programs, and mandated quotas such as competition, minority business set-asides, etc.. They foster filling quotas, not getting the best for least.

We don't need larger budgets - just smarter use of what we have.

I think 6% is adequate.

We should more efficiently use it.

In the USAF spare parts levels are declining due to inadequate funding. As peacetime and wartime (WRM) levels decline mobilization becomes more important. The Defense Budget should be adequate to fully fund computed wartime requirements (WRM) and the WRM stocks should be held inviolate. That will require full peacetime spares funding also.

But I will comment that the halycon days are over. My view is that the defense budget will decline over the next four years.

The Defense Budget should support the defense needs of the nation. Its relationship to GNP is a statistic - really of little value to anyone but an economist.

Question j.

No incentive for either side. No budget, impossible acquisition process - therefore, no incentive.

My comments at h apply.

The Government needs to identify and fund mobilization efforts. For example: Tooling for out-of-production systems should be maintained by industry. Storage and maintenance of the tooling should be funded by the Government.

No statement can be further from the truth. Our contracting procedures - and our method of awarding contracts insures no planning for contingencies.

In the 28+ years of my experience the cooperation between industry and the services is at the lowest ebb. Contractor bashing has become the vogue. The \$600 ashtray and \$7,000 C-5 coffee-pot were never bought. Yet, most of the public believes the services were stupid enough and the contractors crooked enough to cut such deals. Let's look at "mandated" accounting rules that result in such pricing.

Question k.

Looking at aerospace, Rockwell, Vought, and Grumman are recent "drop-outs" from prime status. The number of shipyards is greatly reduced. In another 5 years there will be little competition by U.S. companies.

I suspect the base is as "sound" as it's going to be.

Since I think mobilization has to be accomplished rapidly, I also think that industry currently is engaged in defense production is the only industry that can be mobilized rapidly enough to be of value in future conflicts. The defense industry size has declined, for many reasons, making timely industrial mobilization doubtful.

Our industrial base is declining.

Question l.

Same as above.

See K.

I imagine we can produce what is needed for short conflicts.

Question m.

I think defense should work more with Congress to foster greater industry cooperation but my view is that Congress has a different agenda.

Due to the external pressure to sign up for un-maintainable schedules at almost un-attainable costs just to get a contract, virtually every if not every major program is behind schedule and above cost. To rub salt in an open wound the contractors are even further penalized by payment withholds further exacerbating the cash flow problems.

Question n.

Process is stagnant - not pursued - lacks currency with technology.

I think defense has a pretty good handle on the problem. What we need is the national will to solve it.

Question o.

No comments.

Question p.

I'm not aware of this being true.

I've been away from the Pentagon too long to answer this automatically, but I feel we're pretty far behind.

Do not know.

Topic 3: Problems with the Current U.S. Industrial Base

Question a.

The need for defense expenditures in relation to other budget priorities is declining in the public's view.

The U.S. economy is fueled by profit.

I really had trouble ranking these; all of them are so pertinent.

Question b.

In fact, I think 18 months is optimistic, very optimistic.

But 18 months seems very optimistic.

It is my view that future wars involving the U.S. can be "come as you are" wars and if production rates will not increase significantly for 18 months we will need an 18 WRM stockpile. That will cost too much. Thirty to 45 day reaction time is required.

18 months is optimistic for key components such as forgings, connectors, chips, and like type items.

You could throw a billion dollars into General Dynamics - they couldn't double production in several years!

Because for short duration conflicts you better have what you need on hand.

Topic 4: Your View of the Current Conditions

Question a.

Mobilization and WRM policies need to be considered together. If we have a 30 day WRSK/BLSS the mobilization must be geared to meeting wartime requirements within 30 days. If that isn't the situation, our readiness will decline rapidly after 30 days pass and will not improve until mobilization is effective and stocks are in the hands of combat units.

I strongly feel unless there is a turn-around in the DOD workplace on how they treat contractors not only will our mobilization base be wiped out - but we'll be buying weapon systems from overseas.

I wonder in the context of a short duration conflict, if mobilization of industry doesn't become a non-issue, because you have to have stockpiled what you need to engage an enemy. If a major conflict between superpowers were to occur, it may rapidly escalate to a nuclear exchange, again a short duration scenario. If a nuclear exchange were not to occur then perhaps the only hope for industrial mobilization would be that public opinion would get behind the war and make it happen, as in WW II. In the Korean and Vietnam Wars I don't recall us having "mobilization" problems. It seems like industrial preparedness preparedness was adequate.

The Defense Industrial Base has been and is continuing to erode. It does so for many reasons. First and foremost. . . the method of contracting. The micro-management of everything bought by the government drives contractors either away from doing business with the government - or drives them to a level of mediocrity that cannot compete in the open marketplace. The bureaucracy in government/contractor action adds 25% to the total bill. When you get past that - the recent merger mania absolutely insures our industry cannot do anything for the "long term" or else the raiders will get you. Merger mania has done more to destroy our industrial base than anything else. I could write a book on the subject.

In shrinking budget years - anything not tied to a "tail-number" is going to get short rations. When the Chief is retiring squadrons of current airplanes - its hard to get his attention on funding some production line "just-in-case".

I think you're looking at a very important subject. The point I'm trying to make in my reply is that we're dealing with a very large issue here. It's much larger than military preparedness. Question Q really describes the problem. We're talking about our future economic and military status as a nation.

The Defense Industrial Base is often highlighted as one of the leading national issues by Government executives. However, very little action is taken because it cannot compete with other "Gold Watches" and pork barrel items for budget resources. This plus an acquisition policy that defeats any incentive for industry to stay in the defense business let alone make an investment for something that is as uncertain as the support of a "coming" war makes the environment for the development of a meaningful plan and implementing program almost useless. The existing Government structure is fragmented and lethargic but could be made to do the job with certain changes. Until the subject of defense preparedness is

accepted as a priority issue by the Executive and Congress little progress will be made. This is further exacerbated by the changing attitudes (apparent but not proven) of Russia. I don't believe you could get one dime for preparedness that involved the industrial base from Congress today.

Until such time as the DOD in conjunction with the Department of Commerce, Department of Transportation, and maybe other government agencies - sit down with industry and come up with a viable - long term plan - that include the laws that must be changed - the rules/regulations that must be changed - and a convincing story to sell the American people (and Congress) we won't do anything. The people have to know just how vulnerable our base is - They don't and Americans don't work non-problems. Make it a problem - and it'll get worked.

Appendix C: Round Two Delphi Survey

Mr. John Doe
0000 AFIT Drive
Fairborn, OH 45324

Dear Mr. Doe:

Thank you for completing round one of the Delphi Survey on industrial mobilization. Your comments provided valuable insight to this research project.

The second round Delphi questionnaire containing respondent feedback is attached. You will note that the feedback provided for each question includes the mean ratings of the respondents as well as your response on the first round Delphi questionnaire. Please read and consider the comments provided by the other participants in making your responses on this questionnaire.

Once again, I wish to thank you for the time you are investing in this project. I would ask that you please try and return, in the envelope provided, your completed survey within one week. Due to the time factor of this project I was forced to send out the next round of questions without having received responses from all participants. If you wish to be included in this research project, it is important that you respond in a timely manner.

MICHAEL T. ENGLAND, CAPT, USAF
Graduate Student
Graduate Logistics Management Program
School of Systems and Logistics

2 Atch
1. Delphi Survey
2. Return Envelope

Round Two Delphi Survey

Survey Objectives:

- a. To solicit expert opinion about factors concerning the U.S. industrial base and its ability to mobilize.
- b. To determine what elements of industrial preparedness planning should be considered for an effective industrial mobilization policy.

Definitions:

- a. Industrial Mobilization: The conversion of the commercial economy to wartime production.
- b. Industrial Surge: The initial rapid acceleration of the production of war materials while maintaining commercial output. The first step of industrial mobilization.
- c. Industrial Base: Industries, both those privately and publicly owned, engaged in the production of war related materials.
- d. Industrial Preparedness: The ability of the industrial base to produce war materials in case of industrial mobilization.

General Comments:

- a. During this round of the survey you will be provided with the questions from the first round that were considered to be a consensus, attaining an agreement of 70% or higher by the participants. You will also have representative comments that are meant to provide "food for thought" as you answer this round of questions. You will be given an opportunity to respond to the feedback provided.
- b. Some questions do not need further examination because a consensus was reached. For these questions you will be provided with the consensus response and the percentage agreement.
- c. Your participation and opinions are key to the success of this survey. Please include all your ideas and comments. You may be assured that complete anonymity will be enforced.

Specific Instructions

- a. Please consider the feedback provided with each question before you respond to the question.

b. When a question calls for an answer along a scale, please circle the number which most accurately reflects your judgement on that question or statement.

c. When a question requires a ranking response, please rank order the alternatives, using "1" for the most important item.

d. Please write the rationale for your answers. Include any illustrations, examples, or experiences you have had that will help the other participants understand your response. Please number your comments so they correspond to the question you are answering.

e. If you have any questions about this survey or research project please call Capt Michael England at (513) 233-7939.

Topic 1: HISTORICAL RELEVANCE

General comments:

"I do not think any of our past mobilizations are specifically relevant to present mobilization requirements. However, any experience provides a knowledge base for planning. It is my belief that mobilization will have to become effective in 30 to 45 days max."

"Our weapons come from world wide sources and I see any future wars being of short duration."

"For limited or conventional conflicts the Vietnam experience applies. For all out conflicts where national survival is at risk, I do not think past experience of industrial mobilizations will be helpful."

"World War II was the most impressive buildup to me and we had many advantages then that we no longer have."

"Even though I marked WWII, the period of mobilization started long before 7 Dec. 1941. Though we turned out massive amounts of hardware, we really did not reach full production until close to the end of the war. A war in which we were not under strategic attack as Germany and Japan were."

"The modern competitive society is by far the best base of experience."

Your further
comments: _____

a. Experience from past industrial mobilization efforts remains valid.

Round 1 mean: 2.8

Your round 1 response:

Your new response:

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

b. Which of the past industrial mobilization efforts do you think provides the most significance for future industrial preparedness planning? Please rank order your response.

Round 1 top responses:

Your round 1 response:

World War II
Vietnam
No help
Korea
World War I

_____ World War I
_____ World War II
_____ Korea
_____ Vietnam
_____ No help

Your new response:

_____ World War I
_____ World War II
_____ Korea
_____ Vietnam

_____ I do not think experience from past industrial mobilizations will help in preparation for future conflicts.

Your further comments on Topic 1: _____

TOPIC 2: THE HEALTH OF THE PRESENT INDUSTRIAL BASE

General comments:

"Both the first and second tier would have trouble in responding."

"We couldn't sustain a mobilization if we wanted to."

"Our industrial base is shrinking, strategic metals are scarce and in the hands of people not supportive of us."

"Critical weapon system components are not available in the U.S. therefore, we have little or no control over the source."

"Again, allot of what we need to wage war comes from other sources."

Your further comments: _____

a. The current industrial base has the capability to provide adequate support if mobilized.

Round 1 consensus: 86% disagree or highly disagree.

b. Industrial preparedness planning should focus on a "short war" as opposed to a "long war" scenario.

Round 1 consensus: 86% disagree.

c. Who should be responsible for deciding industrial preparedness planning strategy? Please circle the number of the response you most agree with.

1. The President
2. Congress
3. A committee that includes industry and government membership
4. Other (please specify) _____

Round 1 consensus: 71% agreed with number 3 above.

d. Please rank order the following items from highest (1) to lowest (4 or 5) to indicate the impact you think they have on current industrial base capabilities.

Round 1 top responses:

Defense budget
Dependence on foreign sources
materials availability
Skilled workers

Your round 1 response:

_____ Defense budget
_____ Foreign Dependence Raw
_____ Raw materials
_____ Skilled workers
_____ Other

Your new response:

_____ Defense budget
_____ Dependence on foreign sources for defense related
resources
_____ Raw materials availability
_____ Skilled workers
_____ Other (please specify) _____

Your further
comments: _____

e. There needs to be more emphasis placed on industrial preparedness.

Round 1 consensus: 86% highly agree

f. Please rank order the following items from highest (1) to lowest (5 or 6) to indicate what agencies need more emphasis on industrial preparedness. Check the last item if applicable.

Round 1 top responses:

President's Cabinet
DOD
Congress
Industry
Military Services

Your round 1 response:

_____ The Congress
_____ The President's Cabinet
_____ The DOD
_____ The Military Services
_____ Other
_____ There is enough emphasis

Your new response:

_____The Congress

_____The President's Cabinet

_____The Department of Defense

_____The Military Services

_____Industry

_____Other (please specify)_____

_____I feel enough emphasis is placed on industrial
preparedness

Your further comments:_____

g. The military services are doing an adequate job of industrial mobilization planning in the United States.

Round 1 consensus: 71% neither agree nor disagreed.

h. The military services are doing an adequate job of industrial actions with civilian industry in the United States.

Round 1 consensus: 71% disagree.

i. The Defense Budget should be a larger portion of the GNP (currently it is approximately 6%).

Round 1 mean: 3.1

Your round 1 response:

Your new response

1	2	3	4	5
highly agree	agree	neither agree nor disagree	disagree	highly disagree

Your further
comments: _____

j. The relationship between government and industry is such that it promotes industrial preparedness planning.

Round 1 consensus: 85% disagree or highly disagree.

k. A sound industrial base currently exists for U.S. industrial mobilization.

Round 1 consensus: 85% disagree.

l. A sound industrial base currently exists for United States industrial preparedness.

Round 1 consensus: 85% disagree or highly disagree.

m. The Department of Defense is doing an adequate job of working with civilian industry to assure a sound defense industrial base exists in the United States.

Round 1 consensus: 85% disagree.

n. An adequate review of industrial preparedness is conducted by the Department of Defense.

Round 1 consensus: 71% disagree.

o. The United States government currently has in effect an adequate industrial mobilization plan.

Round 1 consensus: 85% disagree or highly disagree.

p. The United States government has in being an adequate control structure for industrial mobilization in event of war.

Round 1 consensus: 71% disagree.

Your further comments on topic 2: _____

TOPIC 3: PROBLEMS WITH THE CURRENT U.S. INDUSTRIAL BASE

General comments:

"The need for defense expenditures in relation to other budget priorities is declining on the public's view."

"The Defense Industrial Base has been and is continuing to erode. It does so for many reasons, first and foremost is the method of contracting. The micro management of everything bought by the government drives contractors away from doing business or drives them to a level of mediocrity that cannot compete in the open marketplace."

"In shrinking budget years anything not tied to a tail-number is going to get short rations. When the Chief is retiring squadrons of current airplanes it is hard to get his attention on funding some production line - just in case."

"I strongly feel unless there is a turn around in the DOD and the treatment of contractors, should be treated as equal partners, not only will our mobilization be wiped out, but we'll be buying weapon systems from overseas."

"The Defense Industrial Base is often Highlighted as one of the leading national issues by government executives. However, very little action is taken because it cannot compete with the other gold watches and pork barrel items for budget resources."

"Until the subject of defense preparedness is accepted by the Executive and Congress, little progress will be made."

"I don't believe you could get one drive for preparedness that involved the industrial base from the Congress today."

Your further
comments: _____

a. The biggest challenge facing today's current industrial base is: Please rank order from most important (1) to least important (8 or 7)

Round 1 top responses:

Public perception
Government support
competition

Your round 1 response:

_____ Government support
_____ Public perception Foreign
_____ Education of workforce
_____ Foreign competition

_____ Number of workers in the
 skilled trades
_____ Research and development
_____ Other

Your new response:

_____ Government support
_____ Public perception
_____ Education of the work force
_____ Foreign competition in the market place
_____ Research and development
_____ Number of workers in the "skilled trades"
_____ Other (please specify) _____

Your further comments: _____

b. Recent research suggests that it would take approximately 18 months for many facilities to double production rates. Do you see this as a problem?

Round 1 consensus: 85% agree or highly agree.

Your further comments on topic 3: _____

Are there any additional comments you would like to make in regards to this research topic? _____

Thank you for taking part in this survey and sharing your opinions. Please mail this survey in the self addressed stamped envelope provided.

Appendix D: Delphi Round Two Comments

Topic 1: Historical Relevance

Question a. and b.

My hangup is the word valid. If it means "has value" then past experience has got to have some value and I can agree with the statement. But I remain convinced that mobilization in the future is a different ballgame.

Since WW II we have failed to obtain a national consensus that supported any of our engagements. This must come first. Then we must look to the sources of our suppliers today - domestic and overseas. Thus, it follows that we may spend more effort on high technology substitution than on acquiring masses of materials. Mobilization of our industry has a character I have not seen addressed in serious discussions to date.

Industrial preparedness of the future should be geared to strategic material, strategic products for our basic needs during wartime - we can't keep factories in readiness - but we can keep material and processes.

Again, I do not think experience is particularly relevant to future conflict. WW II mobilization was the most extensive thus providing the most experience, but it nor other mobilization efforts can be used as a road map for future mobilization.

I believe there is considerable historical relevance in our past mobilization efforts and we're not paying enough attention to lessons learned.

Military success is based on lessons learned!

Mobilizing in the future may not be limited to major power confrontations. It may well be a combination of escalation/mobilization with early attrition in some areas and not in others. Given the rising third world unrest, a whole range of scenarios is possible with Vietnam being the closest experience to what could likely happen.

I would like to emphasize my "Round One" comment that mobilization must be effective within 30 to 45 days. The 30 to 45 day criteria is linked to our WRM policy which is designed to provide support for 30 to 45 days. But, if WRM is not fully funded then mobilization will have to be effective sooner. It is vital to understand the relationship of WRM policy, WRM funding, and mobilization.

I see an all out conflict where our national survival is at risk as a war that will be fought with the weapons in hand -a "come as you are" event. All other conflicts will require mobilization that is consistent with our national commitment, political alignments (Allies) and the balance between consumer needs (and wants) and the military material requirements to conduct a successful military operation.

Topic 2: The Health of the Present Industrial Base

Question d.

Without incentives we cannot expect private enterprise to invest in the maintenance of an industrial base.

We need to have the funding and materials available as our baseline. We should have better stockpiles.

I recognize the problem of U.S. reliance of foreign minerals. It is extensive. But, I do not think raw materials will play an important role in mobilization. The time to convert raw materials into weapon system components is too long to be useful considering WRM policy and funding.

The industrial base is locked into production lines with methods based on peacetime business projections. While modernization is encouraged (IMIP etc.) flexibility for surge is not. Critical material stockpiling, contingency surge production planning, flexible assembly lines, and procedures aren't paid for by cost conscious weapon system offices. Government policies and controls are heavily compliance oriented. The economy is not really a free-enterprise and not really government controlled but a confusing mix which incentivizes or penalizes not in conformance to any overall policy. The economic structure of the industry needs to have a policy driving it.

Question f.

Congress must be convinced of the magnitude of the problem, particularly in this day and age. After further thought, I guess the Military Services must stand up for themselves.

I place industry last because it will respond to direction (contracts) and funding from DOD.

If one assumes the fundamental structure of the defense industry needs changing, then wide-spread consensus is needed and Congress must lead and the President's cabinet must support.

Question i.

I'm not for >6% of the GNP - We could do much if politics were removed from the budget process - but that will never happen.

The Defense Budget is adequate. The distribution between weapon systems appears to be one of making everyone happy as opposed to supporting a strongly and clearly defined single military strategy for the nation.

I continue to disagree. We have to do more in defense with less.

While I would like to see the Defense Budget allocation increase, political realities make it very unlikely.

We need to fully fund WRM requirements - that takes money not in the defense budget - so the budget should be increased.

More money thrown at the same general policies with instructions to "think industrial preparedness" will become a big boondoggle and not solve the major issue. It must be in a contractor's best economic interest to structure production processes, maintenance of 2nd tier suppliers, etc. towards industrial preparedness - not towards minimum production cost for his best.guess of a government production run on system "z".

We are deluding ourselves if we think we have a well defined industrial base or if the maintenance of same is a major consideration in our acquisition planning or execution process. We have not identified our industrial base requirements and related same to our long range weapon systems support plans. A national effort is required to get this issue before the public, get it supported and the solution implemented. This is the responsibility of our Executive Branch of Government.

Topic 3: Problems with the Current U.S. Industrial Base

Question a.

I've said enough on my basic theme. Government support can lead public perception it isn't likely to happen the other direction and isn't necessary. We need an industrial/Government consensus group to convince Congress to act more rationally - this will take years but can be made to happen.

I hold to my prior response: public perception is the biggest problem.

The problem is big but so are the obstacles. Operation Ill Wind, contracting micro-management, little Congressional interest make it difficult to offer solutions.

If we get our act together, we can handle the foreign competition.

Question b.

No big surprise here. I've never seen a SON requiring this - did we expect it for free? Do we really think contractors are designing to not make this happen?

This is the major problem with mobilization. It just is not responsive soon enough.

Articles in the April 89 issue of the ADPA Journal National Defense tout lead time reduction and graduated mobilization response as ways to deal with the lag in becoming mobilized. The first is something DOD and industry could do something about. The second, start mobilizing in anticipation of conflict, seems risky, depending on intelligence which may be questionable.

Bibliography

1. Air Force Logistics Management Center. The Logistics of Waging War. Gunter AFB AL, 1983.
2. Albrahmson, James L. The American Home Front. The National Defense University Press, Washington DC, 1983.
3. Backman, Jules et al. War and Defense Economics. New York: Rinehart & Company, Inc., 1951.
4. Baldwin, Hanson W. "The Military Move In," Harper's 195: 481 (December 1947).
5. Baruch, Bernard M. American Industry in the War. New York: Prentice-Hall Inc., 1941.
6. Baumbusch, Geneese G. et al. Defense Industrial Planning for a Surge in Military Demand. Rand Report (A-2360-AF), September 1978.
7. Berger, Carl. The United States In Southeast Asia 1961-1973. Washington: Government Printing Office, 1984.
8. Blackwell, James. "Industrial Base: No One At The Top," Military Forum. Vol. V No. 7: 47-49 (May 1989).
9. Borg, Walter R. and Meredith D. Gail. Educational Research: An Introduction (Second Edition). New York: David McKay Company, Inc., 1971.
10. Brown, Bernice B. Delphi Process: A Methodology Used for the Elicitation of Opinions of Experts. Santa Monica CA: Rand Corporation, September 1968 (AD-875981).
11. Campbell, Lewis H. The Industry-Ordnace Team. New York: McGraw-Hill Book Company, Inc., 1946.
12. Clarkson, Grossvenor B. Industrial America in the World War. New York: Riverside Press, 1923.
13. Clem, Harold J. Mobilization Preparedness. National Defense University Press: Washington DC, 1983.
14. Codd, L. A. American Industry and Our National Defense. Princeton New Jersey, Bracket Lecture Comittee, Princeton University, 1937.
15. Commission On Merchant Marine And Defense. Findings Of Fact And Conclusions. Washington: Government Printing Office, 1988.

16. Correl, John T. "The Power Projection Shortfall," Air Force Magazine, Vol. 3 No. 8: 38-42 (August 1988).
17. Dalky, Norman C. DELPHI. Santa Monica CA: Rand Corporation, October 1987.
18. -----. The Delphi Method: An Experiment Study of Group Opinion. Contract F44620-87-C-0045. Santa Monica CA: Rand Corporation, June 1989 (AD-890498).
19. Department of Defense. Dictionary of Military and Associated Terms. Washington DC, 1987.
20. Department of the Air Force. Compendium of Authenticated Systems and Logistics Terms, Definitions, and Acronyms. AU-AFIT-LS-3-81. Wright-Patterson AFB OH, Air Force Institute of Technology, School of System and Logistics, 1 April 1981.
21. Einstein, Charles B. and Jack W. Einstein. "From the Uniformity System to Flexible Manufacturing," Army Logistician 4: 34-38 (July-August 1988).
22. Ellison, John K. et al. Mobilizing U.S. Industry. Westview Press Inc., Boulder Colorado, 1988.
23. Ferrel, Robert H. Woodrow Wilson & World War I (1917-1921). New York: Harper & Row Publishing Company, 1985.
24. Feslser, James W. et al. Industrial Mobilization for War Vol. 1. Washington: Government Printing Office, 1947.
25. Fleming, Lieutenant Colonel Paul A. et al. The Ability of the Industrial Base to Mobilize. Industrial College of the Armed Forces, National Defense University, May 1983 (AD-A138186).
26. Fowler, Donald R. and Rita A. Frigs. "Leadtime Zero Revisited," National Defense Vol. LXXV No. 447: 27-30 (April 1989).
27. Fowler, Henry H. "The Mobilization Base Concept," Federal Bar Journal, Vol. XIII No. 3 (April-June 1953).
28. Gansler, Jacques S. The Diminishing Economic and Strategic Viability of the U.S. Defense Industrial Base. The American University, Washington DC, 1979.
29. Gill, Timothy D. Industrial Preparedness. National Defense University Press: Washington, DC, 1984.
30. Gorlaski, Robert and Russel W. Freiberg. Oil & War. New York: William Morrow and Company, Inc., 1987.

31. Grossman, Larry. "Industrial Base: The Supplier Bottleneck," Military Forum Vol. V No. 7: 40-48 (May 1989).
32. Heiser, Joesph. Logisitics Support: Vietnam Studies. Washington: Government Printing Office, 1974.
33. Huston, James A. The Sinews of War: Army Logistics 1775-1953. Washington D.C., Department of the Army, Office of the Chief Military History, 1986.
34. Industrial College of the Armed Forces. Emergency Management of the National Economy Vol. 1. Introduction to Economic Mobilization. Washington: Government Printing Office, 1954.
35. Industrial College of the Armed Forces. The Future Role of Mobilization in National Security. National Defense University Press, Washington DC, 1986.
36. Korabil, Leon et al. The Army Production Base, Vol. 1. Operations Research Office, The Johns Hopkins University, Bethesda Maryland, January 1980 (LDO-822A).
37. Libicki, Martin C. Industrial Strength Defense. National Defense University Press, Washington, DC, 1988.
38. Marr, Roy T. "Industrial Mobilization as an Element of Logistics," Army Logistician Vol. 21:26, October 1987.
39. Marrin, Albert. The Yanks Are Coming. New York: Mcmillian Publishing Company, 1986.
40. Marshall, George C. et al. The War Reports of General George C. Marshall, General H. H. Arnold, and Admiral Ernest J. King. New York: J.B. Lippincott Company, 1947.
41. Morrison, Samuel E. The Oxford History of American People. New York: Oxford University Press, 1985.
42. Merrit, Hardy L. and Luther F. Carter. Mobilization and the National Defense. National Defense University Press, Washington DC, 1985.
43. Muckerman, Joesph E. and James Miskel. "Mobilization: Neglected Bulwark of National Security," National Defense, Vol. LXXV No. 47: 37-40 (April 89).
44. Mulkey, Jesse G. "Defense Acquisition and Improved Responsiveness of the U.S. Industrial Base," Defense Science 2000+ Vol. II: 53-59 (June 1983).
45. Nelson, Donald M. The Arsenal of Democracy. New York: Harcourt, Brace and Company, 1946.

46. Novick, David et al. Wartime Production Controls. New York: Columbia University Press, 1949.
47. Peppers, Jerome G. Jr. History of United States Military Logistics 1935-1985. Logistics Education Foundation Publisher, Huntsville AL, 1988.
48. Prather, Lieutenant Colonel Thomas L. Industrial Mobilization--The Ability to Respond. Student Essay, U.S. Army War College, Carlisle Barracks, Pennsylvania, May 1982 (AD-A16200).
49. Pursell, Carrol M. The Military Industrial Complex. New York: Harper & Row, 1972.
50. Sackman, H. Delphi Assessments: Experts Opinions, Forecasting, and Group Process. Santa Monica CA: Rand Corporation, April 1971 (AD-786878).
51. Schieber, Harry N. et al. American Economic History. New York: Harper & Row Publishing Company 1970.
52. Schnabel, James F. U.S. Army In The Korean War-Policy and Direction: The First Year. Washington: Government Printing Office, 1972.
53. Smith, Meritt R. "Military Arsenal And Industry Before World War I," War, Business and American Society. Edited by B. F. Cooling. Kennikat Press Corporation, Port Washington NY, 1976.
54. Smith R. Elberton. The Army and Economic Mobilization. Department of the Army: Washington DC, 1959.
55. Simonson, G. R. The History of the American Aircraft Industry. M.I.T. Press: Cambridge MA, 1968.
56. Stockton, Richard. Inevitable War. New York: The Perth Company, 1932.
57. Taylor, Lawrence B. Financial Management of The Vietnam Conflict 1962-1972. Washington: Government Printing Office, 1974.
58. The Air Force Association. Lifeline in Danger: An Assessment of the United States Defense Industrial Base. The Aerospace Education Foundation, September 1988.
59. Under Secretary of Defense (Acquisition). Bolstering Defense Industrial Base Competitiveness. Washington: Government Printing Office, 1988.

60. U.S. Congress House of Representatives, Committee on Armed Services Panel on the Defense Industrial Base. The Ailing Defense Industrial Base: Unready for Crisis. Hearings, 98th Congress, 2nd session, 1980. Washington: Government Printing Office, 1980.
61. U.S. Office of Defense Mobilization. Building America's Might. Report to the President. Washington: Government Printing Office, April 1951.
62. U.S. Office of Defense Mobilization. The Battle for Production. Fourth Quarter Report to the President. Washington: Government Printing Office, January 1952.
63. U.S. Office of Defense Mobilization. Three Keys to Strength Production, Stability, and Free World Unity. Third Quarterly Report to the President. Washington: Government Printing Office, October 1951.
64. U.S. Senate. Senate Committee on Armed Services, Ammunition Shortages in the Armed Services. Hearings before the Preparedness Subcommittee No. 2, 83rd Congress, 1st Session. Washington: Government Printing Office, 1953.
65. Van Creveld, Martin. Technology and War. New York: The Free Press, 1989.
66. Vawter, Roderick L. Industrial Mobilization: The Relevant History. National Defense University Press, Washington DC, 1983.
67. Ward, John Carrelton Sr. Planning for Our Future National Security. Address at the Army Industrial College Washington DC, 1951.
68. Westover, John G. Combat Support In Korea. Washington: Government Printing Office, 1987.
69. Wilson, Charles E. Preparedness as a Continuing Policy. Address to the American Ordnance Association, Cincinnati OH, 1951.
70. Wynn, Neil A. From Progressivism to Prosperity. New York: Holmes & Meier Publishing, Inc., 1986.

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→ The capability of the U.S. industrial base to mobilize could mean the difference between victory and defeat in any future conflict in which the U.S. might find itself. Since World War I and the introduction of mechanization into combat the industrial base has played a major role in modern warfare. The industrial might of the U.S. grew to the point that it became known as the "Arsenal of Democracy" in World War II. There is evidence which suggests the once powerful U.S. industrial base has been eroding for sometime and can no longer meet the production demands of war. This analysis traced U.S. industrial mobilization from 1918 to 1988. The objective of the research was to examine past industrial mobilizations to see what was successful and what was not in mobilizing the industrial base. What became readily apparent is mistakes have been repeated time and time again with regards to industrial mobilization. *Keywords: --> to FLD 18*

Another objective of the research was to assess the capability of the current industrial base to mobilize. A Delphi survey was conducted in hopes that the participants, with their extensive experience and knowledge of the U.S. industrial base, could provide some insight into the present condition of the industrial base.

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